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July 2015
Issue 417

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- Four-bay NAS boxes compared
- BenQ's 27-inch FreeSync screen
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WINDOWS 10 IS ALMOST HERE!

Find out what to expect in our extensive hands-on preview!

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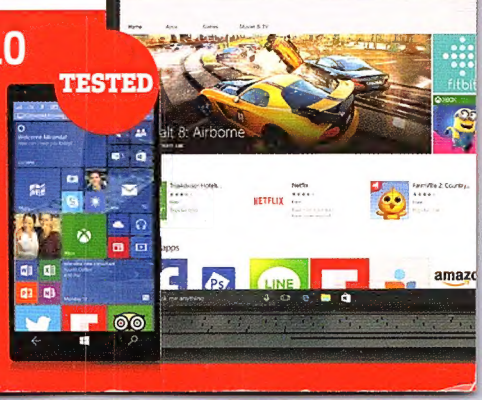

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Future Publishing Australia,
PO Box 1077, Mount Street, North Sydney, NSW 2059
Tel: 02 9955 2677 Fax: 02 9955 2688
SUBSCRIPTION ENQUIRIES: Please call Magshop 13 61 16
Email: apcmag@futurenet.com
Web: www.apcmag.com

EDITORIAL
Editor-in-Chief **Dan Gardiner**
Managing Editor **Melanie Pike**
Journalist **Joel Burgess**
Journalist **Stephen Lambrechts**

ART/PRODUCTION
Creative Director **Troy Coleman**
Senior Designer **Nykke Coleman**
Designer **Sharnee Brisbourne**

CONTRIBUTORS
Ben Andrews, Matt Beilby, J.R. Bookwalter, Helen Bradley, David Chartier, Simon Chester, Simon Crisp, Ian Evenden, Lindsay Handmer, Lucy Hattersley, Dave James, Jeremy Laird, Rod Lawton, Tuan Nguyen, Nick Peers, Les Pounder, Matthew JC. Powell, Matthew Sakuraoka-Gilman, Chris Thursten, Alexander Tolstoy, Robin Valentine, Luis Villazon, Darren Yates

SENIOR MANAGEMENT
Chief Operating Officer **Neville Daniels**

COMMERCIAL
Sales Director Paul Marttila
paul.marttila@futurenet.com

Senior Sales Manager Jairo Manzoupo
jairo.manzoupo@futurenet.com

Account Manager Joshua Kitson
joshua.kitson@futurenet.com

ABOUT THE MAGAZINE
APC is published by Future Publishing Australia.

Distributed in Australia and NZ by Network Services.

Printed by Webstar
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FIPP

2015 in tech: the best stuff is still to come

APC's editor outlines what big PC releases we can expect in the second half of the year.

While 2015 may already be half over, it's basically just getting warmed up when it comes to hot new PC tech. In August we should see the launch of Intel's mainstream Skylake platform. The latter's been slightly delayed, but consists of 6th-generation Core i processors and 100-series motherboards (led by the flagship Z170). In fact, the motherboards are just about ready to go – we recently saw a full line up from Gigabyte (one of which is above) as well as a smaller selection of boards from ASUS, MSI and ASRock.

And from the gaming camp, we've got AMD's new 300-series graphics cards due to arrive around the time you read this. We're still waiting on our test units, but we're obviously keen to see how the red team's top-end gear stacks up against Nvidia's latest offerings.

GPUs are, of course, only half of AMD's business though, and the company's also looking to make a splash in the budget laptops space, courtesy of a completely reworked mobile APU that's designed to target the $500-$1,000 area, where the bulk of laptops are sold. Based on some early hands-on previews, it does look quite promising – although the proof, as always, will be in the final units, which will be hitting retail over the next few months and beyond.

Then, of course, there's the big release that almost every PC lover has been waiting for: Windows 10. Microsoft has finally announced a release date for the OS of July 29th, which is when owners of Windows 7 and 8 devices will be able to download the new OS as a free upgrade. We're quietly hopeful that this will undo a lot of the missteps that happened with Windows 8.

That's not all there is to get excited about in PCs, of course. I've just returned from Computex in Taiwan, which is to core PC technology what CES in Vegas is to gadgets. We'll have more on the most-interesting trends and bits of kit we saw next issue; it should all start to trickle onto the market in the following months.

LIMITED-TIME SUBS OFFER

And speaking of the future, I'd like to take a quick moment to bang our own drum, if I may. If you're a regular reader of *APC*, you'll want to check out our special subscription offer on page 26. It's our lowest price to date (saving you around half the cover price) and we're even including a free 12-month subscription to the SecuraLive Internet Security suite for PC. If you're a current subscriber, you can still take advantage of this offer even if you're not yet due for renewal – the extra 12 months will simply be added onto your current subscription period.

Regardless of if you're a subscriber or not, I hope you'll join us for the rest of 2015 – because there's plenty more great stuff to come for the PC! ■

DAN GARDINER
EDITOR-IN-CHIEF
dan.gardiner@futurenet.com

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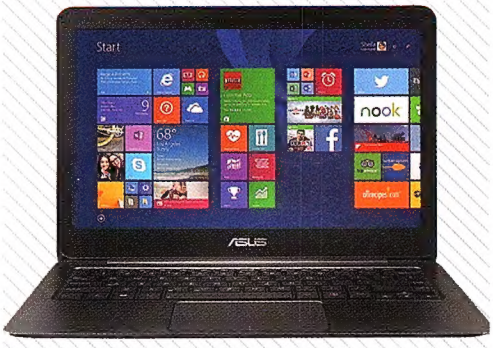

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Suits to the rescue?

iiNet providing pro-bono legal support to pirates as other ISPs join *Dallas Buyers Club* producers' list of targets.

With Voltage Pictures winning its case against iiNet and several other Australian ISPs, the production company can now take its request for names and physical addresses of the providers' customers who have illegally downloaded the film *Dallas Buyers Club* to the Federal Court of Australia.

If you're one of the 4,726 people suspected of downloading the film, you're probably more than a little bit worried about what might happen to you. Chances are, you've been nervously looking at your mailbox, waiting for a letter demanding some form of compensation.

Thankfully, iiNet has your back – the ISP has announced in a blog post that it is working with a law firm that has offered to provide pro-bono support to any of iiNet customers who've received such a letter.

In order to prevent people from receiving exaggerated compensation claims, it has been stipulated that all infringement notices must be signed off by the Federal Court of Australia before being sent out. iiNet has suggested that the damages sought could be as little as "the fee that would have been paid had the film been lawfully downloaded. This could be around $10."

Don't assume that you're in the clear just because your service provider wasn't involved in the initial case, as Voltage Pictures has revealed that it is now going to pursue the ISPs that weren't included the first time around, such as Telstra, Optus and TPG. Speaking to Mashable, Voltage Pictures' lawyer Nathan Mattock said that his client would be "writing to the other ISPs in the next week seeking consent to similar court orders as those obtained against iiNet." Mattock also stated that the technology used to capture pirates in the iiNet case was a test case that only ran for a month, and that Voltage has expanded its plan to use that technology over a 12-18 month period, aiming to capture the IP addresses of copyright infringers from all of Australia's other ISPs. **Stephen Lambrechts**

Canadian teen guilty of swatting female gamers

17-year-old member of Lizard Squad hacker group admits to terrorising female *League of Legends* players.

In May, a 17-year-old self-proclaimed member of hacker group Lizard Squad faced a British Columbian court for 23 charges of extortion, public mischief, false police reports and criminal harassment. Going by the online name of "Obnoxious", the teenager was reported to have used government resources to harass female *League of Legends* players that ignored his Twitter and in-game friend requests. Unphased by the illegality of his actions, Obnoxious posted an 8-hour video stream (**tinyurl.com/APC417-swat**) of one swatting incident on December 1st, where the teenager tells police that he is in possession of five hostages, a semi-automatic rifle and six bombs and will begin killing hostages if the police did not bring him $20,000. With a list of swatting incidents dating back to 2013, the teen plead guilty to all charges, although according to Canadian publication *Tri-city News*, he

appeared to be remorseless during the conviction hearing. One victim was so traumatised by the multiple SWAT raids and the public release of sensitive personal information (like credit card details and phone numbers) that she was forced to abandon her degree at the University of Arizona. Obnoxious will be sentenced at Coquitlam court on the 29th of June. **Joel Burgess**

An internet of Facebooks

Social-networking giant's Internet.org accused of violating net neutrality.

Pitched as an attempt to give internet access to the two thirds of the world that can't afford it, Facebook launched its first Internet.org initiave in Zambia in July 2014. Moving quickly since then, this year alone it has established itself in Colombia, Ghana, India, the Philippines, Guatemala, Indonesia, Bangladesh and Malawi. Facebook establishes Internet.org by partnering with a local telco (Reliance Communications in India, for example) and offers free access to a clutch of sites, but charges for anything outside these. Though the 38 approved sites in India includes Wikipedia, Bing and a number of reputable media outlets, the list of noteworthy exclusions is obviously much greater. But as the project rapidly expands, so too does the belief that the internet.org program violates the fundamental principals that form the bedrock of the internet. International digital rights advocacy group Access Now has posted an open letter, representing the interests of a consortium of individuals from around the world who are displeased with aspects of Internet.org's implementation. That includes a laundry list of objections against the Facebook initiative, such as violating net neutrality, pertaining incorrect nomenclature, the potential for creating a two-tiered internet, promoting an insecure platform and opening up opportunities for the misuse of personal data and political suppression using the platform. The telecommunications ministry in India seems to have reached a similar conclusion, setting up a specific committee that will oversee the future governance of net neutrality in the country. Joel Burgess

Aussie Netflix and gaming tax inbound

It was bound to happen eventually.

Netflix's high-profile arrival on our shores has brought to light a loophole that has allowed overseas digital services to sell their products in our country without charging customers a Goods and Services Tax. That's about to change however, as a new 'Netflix Tax' has been introduced as part of the Federal Budget for 2015.

According to the Exposure Draft posted on the Australian Government's Treasury web site, the proposed bill will be "extending GST to digital products and other services imported by consumers," which will include pretty much any digital thing you can purchase, including music from iTunes, e-books from the Kindle Store, overseas streaming services and downloadable video games from Steam.

Australian Treasurer, Joe Hockey said that it's "unfair that overseas based businesses selling services into Australia may not charge GST when local businesses have to charge GST," further stating that "a local business that employs Australians, pays rent in Australia, pays tax in Australia, and helps build our economy is disadvantaged by the current system."

Stephen Lambrechts

Sydney Siege hearing takes the internet as its stage

Courts begin live-streaming proceedings.

The coronial inquest into the deaths resulting from the Sydney Siege brings a first for an inquest: it's being held within a secure courtroom that is capable of live-streaming the hearing over the internet . Beginning May 25th and expected to continue into 2016, the proceedings can be viewed online by the public at (**lindtinquest.justice.nsw.gov.au**). The contemporary purpose-built courtroom in the John Maddison Tower of Sydney's CBD also contains 23 HD TV screens, and a 75-inch TV in an adjoining media room. **JB**

Paranoid Android

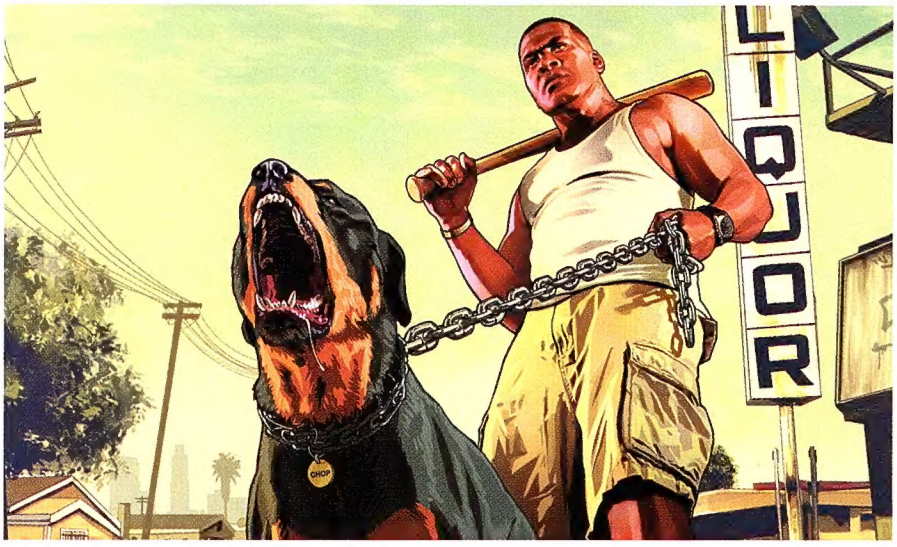
A factory reset probably won't delete your Android's data.

When Cambridge University researchers set out to test if any user data was recoverable after factory-resetting an Android device, they probably weren't expecting what they found. Testing 21 phones from five manufacturers the results were pretty shocking, with all the devices retaining either some or all of the contact data, images, video, SMSs and email correspondence stored on the device. On 80% of the devices, the researchers were also able to extract Google's master security token, allowing them to reinstate everything from Gmail accounts to contacts. From this sample group, the researchers estimate that 500 million Android devices don't fully wipe disk partitions, and 630 million don't wipe SD cards. **JB**

Solitaire back for Windows 10

Microsoft reinstates productivity-gap filler.

It could be argued that the Windows 10 platform is Microsoft's attempt to get back to basics. A shining symbol of this is the announcement that, after being conspicuously culled from Windows 8, the card-game *Solitaire* will once again be embedded into the OS. We guess the rationale behind it is: You're going to need something to do with all the free time offered by its new and efficient applications... [We can only hope! - Ed] **JB**



1PETABYTE

THE AMOUNT OF BANDWIDTH USED BY GTA V PIRATES IN ONE DAY.

Tuesday, April 14th marked the long-awaited arrival of *Grand Theft Auto V* on PC, and although it took a day for a 'cracked' pirated copy to appear (courtesy of a Chinese game forum), once it was out, thousands of pirates began propagating it. By Thursday morning an estimated 20,000 copies of the 60GB game had been plundered through BitTorrent, amounting to over 1 million gigabytes of data. That's the equivalent to all US internet traffic of any given day in the year 2000.

US $83.70

HOW MUCH IT COSTS TO MAKE AN APPLE WATCH.

Considering it'll cost you a minimum of AU$500 to slap one on your wrist, it's rather surprising that a teardown report by IHS Technology found that a basic Watch Sport only costs US$83.70 (~AU$110) to manufacture. With material costs adding up to only 24% of the US RRP, the Watch notably undercuts Apple's usual manufacturing/price ratio of between 29% and 38%. This dramatically increased profit margin — on the most value-for-money Watch variation — suggests a completely new tactic in Apple profit making.

22 Mbps

THE AVERAGE INTERNET SPEED IN SOUTH KOREA.

Cloud service provider Akamai Technologies recently released its fourth-quarter State of the Internet report for 2014. Taking out the highest average internet speed was (surprise, surprise) South Korea, which was a good 5.4Mbps faster than runner-up Hong Kong's 16.8Mbps average. Considering Australia was ranked 42nd with an average of 7.4Mbps, we've got a bit of catching up to do...

1mm

THE THICKNESS OF LG'S LATEST OLED TV.

Dubbed the 'wallpaper' TV, this proof-of-concept prototype display is intended to showcase the potential of OLED displays. The 55-inch, 1.9kg and 1mm thick unit was revealed at an LG press event in South Korea, celebrating an OLED-manufacturing milestone the tech company recently hit. OLEDs have traditionally been expensive to produce, as a large proportion of the screens produced are defective. But LG announced it can now manufacture OLED screens with 80% yield rates, which are comparable to more-established display technologies and should reduce the consumer price significantly.

STEAM™

1in5

THE PROPORTION OF LINUX GAMES ON STEAM.

Steam opened its Linux store close to 3 years ago, although currently less than 1% of its customers use the open-source operating system. Considering the Steam platform has close to 125 million registered users, over a million seem to be running Linux. That 1% is pretty spoiled for choice, however: of the 5,398 games on Steam at the time of writing, 1,198 had Linux support.

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» GEAR WE WANT

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This 4K camcorder from Canon looks odd, but it's designed to be lightweight and ergonomic, and is outfitted with a high-quality 10x zoom lens and optical image stabilization, for clear, close-up footage even when hand-held. It can record 4K at bitrates of up to a ludicrous 305Mbps, which will offer absolutely uncompromising detail – consider that Netflix's 4K streaming looks great at 15Mbps. For 4K, you'll need high-end CompactFlash cards, but it can also record beautiful 1080p Full HD video to SD cards.

LILY

US$999 | LILY.CAMERA

Lily is one of those "OK, now we're living in the future" moments. It's a quadrocopter drone with a 1080p camera that follows you, filming. You just throw it (literally) in the air, it rights itself, then floats along videoing you. It's partly following a tracking device that you wear, but it also has some visual recognition capabilities. It has different filming modes, such as purely following, or things like circling around you, and is even waterproof. We've seen some amazing footage of it following snowboarders and mountain bikers, though the 20-minute battery life is a bit of a shame.

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Tesla brings its famous battery technology from cars to the home. These hefty lithium ion batteries are designed to make you less reliant on peak-hours grid electricity, especially if you have solar panels. Most energy use is in the morning or evenings, but most solar energy is gained during the day. The Powerwall can store it in the daytime, then let you use it in the evening. Or you can even just use it to store electricity from the grid at night, when it's cheaper, and use it at peak. There are two models: one for daily use, and another that acts as a backup in case of power outages. The devices are expected to become available in Australia in 2016. ■

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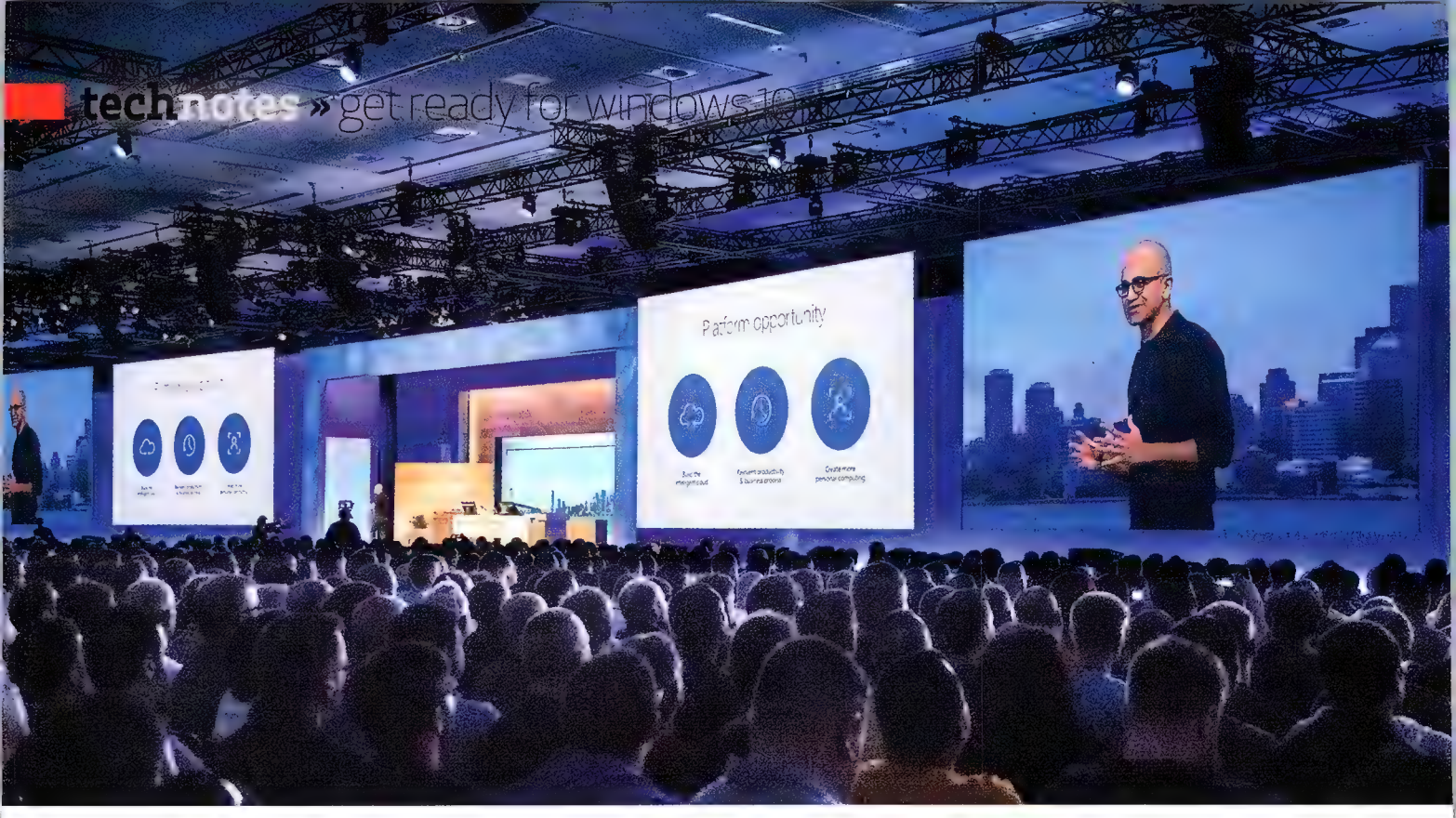


Get ready for Windows 10

Will Microsoft's new operating system be the return to form that everyone hopes? The *APC* team investigates.

We all know that Windows 10 is coming, and soon. AMD's CEO Lisa Su recently suggested, in an earnings call, that it may be released by the end of July and indeed, just as we were going to print the Redmond giant confirmed that July 29th will be the day it officially lands. Like many hardware manufacturers, AMD is hoping for an uplift in sales as people rush out to buy new machines and/or hardware to get the most from Microsoft's latest operating system.

Indeed, a key function of a market that's waiting for a new Microsoft OS is that sales in PCs tend to dip leading up to the release. And that's exactly what's happening at the moment – with the likes of Nvidia lowering its forecast for the second quarter of the year from $1.18 billion down to just $1 billion (yes, we feel bad about using the word 'just' there). Analyst Canalys predicts a 13% fall in desktop shipments in the lead up to the release of Windows 10. Even notebooks, which tend to weather such storms better than desktops, have been hit by a 4% drop in demand.

This could be one of the last times that the 'softening of the market' happens though, as Microsoft has announced there isn't going to be a Windows 11. It's changing how it updates Windows. The big releases we've come to know and love, or hate, are about to be replaced with a much more dynamic model. A service model that should see updates delivered in a more regular manner – though how such updates are going to be financed is still something that needs to be explained.

Windows 10 has changed considerably since we first saw glimpses of what it had to offer with the freely available Technical Previews at the beginning of the year, and we're not just talking about the operating system itself. The unveiling of HoloLens, the ongoing work on Cortana, Continuum, Microsoft Edge (the Windows browser that's a successor to Internet Explorer) and information on what DirectX 12 is really going to do for you has changed the proposition considerably.

So, this month, we've put together this feature to explain all the new bits that are coming to Windows 10 – and what's worth getting excited for.

Back to the Start

MICROSOFT STAKES A CLAIM FOR A UNIVERSAL NEW ERA.

As its 'winter' release edges ever closer, the full features and details of Windows 10 are gradually coming into focus. Much, however, remains unclear. We know, for example, that Win10 will mark the end of Windows Media Center. It's gone, not to be replaced. That's big news. But all we know is that it's dead, nothing more. For our full preview of exactly where Windows 10 stands right now, and what it can do, turn the page. But for the moment, here's a little more detail.

THE RELEASE DATE

Right as we were going to print, Microsoft announced that the free Windows 10 upgrade, which is available to existing users of Windows 7 and 8, will be landing on July 29th – or more likely July 30th in Australia when you take timezones into consideration. The company previously stated that it will launch "in 190 countries and 111 languages".

What's a bit less clear is when hardware manufacturers will receive access to the new OS. Microsoft says that consumers can expect to see new PCs and laptops running Windows 10 'later this year', although a February 2015 report from Windows blog Neowin cites sources claiming Windows 10 will release to manufacturers this June, which would allow laptop, tablet and phone makers ready for the US back to school season with fresh copies of the new OS well.

It's clear then that, not all Windows 10 releases will be treated equally. Microsoft's Joe Belfiore hinted it will likely release for PC first, then later in the year on phones, tablets, HoloLens, Xbox One and more. So, yes, Windows 10 will launch this winter, but not on every screen you own.

MOBILE WIN

Much of the latest technical information has come from Microsoft's Build developer conference, held in April, which was an opportunity for the company to show developers where it is right now.

On the first day of Build, Myerson surprised the crowd when he announced that Windows 10 will support apps written for iOS and Android. With some reworking, of course. Still, this will undoubtedly blow the Windows 10 app store wide open.

So, when Windows 10 for Phones launches later in the year, you'll be able to run Android apps, for example, on phones and small tablets (but not on a Surface, notebook or desktop PC).

They'll run on an Android subsystem that's likely to be based on KitKat (using the same hooks once used to put a POSIX subsystem in Windows NT).

PARANOID ANDROID

But this doesn't mean any Android app will run and there are things they won't be able to do. "We replace the Android services with our own," said Microsoft's Kevin Gallo. "We are running them in our own container – conceptually we are running them as a universal app so we use a middleware layer for translating APIs across, but they still run in the Windows app security model."

That will improve performance and battery life over Android, he suggested. "Apps are not running in the background and there are some changes made so they behave like a well-behaved app." Standard platform capabilities will be redirected to the Windows equivalents – that's the file system, contact and photo integration, camera, sensors and network connections.

Not all Android apps will work well this way. "Messaging apps and those that have deep integration into background tasks will probably have issues running," Gallo told us, "and it also comes down to [where they have good] performance". But then, he pointed out, "not every app works in every Android distribution."

Bringing Android apps to Windows Phones isn't the only way Microsoft is trying to bring developers and their apps to Windows 10. There's also the ability to wrap Win32 and Silverlight apps in the App-V container or to bundle up a web site as an app (complete with API calls to add Windows 10 features) and distribute those through the Windows Store – and iOS developers can bring an Xcode project into Visual Studio and share source code between an iOS and Windows app.

BUILD ON

The Build tidbits were free-flowing, though generally sparce on details. Windows 10 is now available on the

All Hail DirectX 12

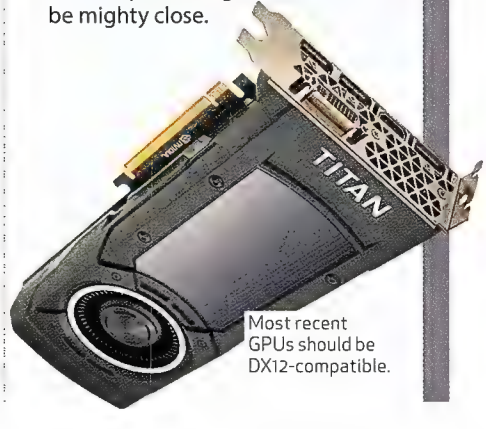
As far as we're concerned, the most exciting aspect of Windows 10 is the accompanying release of DirectX 12. We've been thrilled about the potential of previous iterations of the gaming API, but this is the first time we'll actually see a significant focus on improving performance, as opposed to simply adding a list of features and effects that few developers ever use.

That's partly down to a big reduction in CPU overheads when running games, with Microsoft insisting DX12 will cut CPU loads by an epic 50%. More good news is that it should be compatible with most recent graphics cards and be pushed out across PCs, mobile devices and the Xbox One. One graphics API to rule them all.

It's not clear yet which cards will be compatible, but Nvidia says all its existing DX11 GPUs will do the job. There's no word from AMD, but it's likely that all cards with AMD's GCN, at the least, will be compatible.

Final Fantasy developer Square Enix gave us a little taste of what DX12 can do, at Microsoft's Build Conference, in April, and it got us very excited. Simply put, it's jaw-dropping how realistic the visuals look. What DX12 can do is already stunning. "Each of these scenes is over 63 million polygons," explained Microsoft technical fellow John Shewchuk, during the Build demo. "That's about six to 12 times more than we could do with DX11. Just to give you an idea on the textures you're seeing here," Shewchuk continued, "those are 8K by 8K textures. Significantly more than we were able to do [before]."

Of course, the demo doesn't consider even half of the graphical elements that a game released to the public would have to. The "63 million polygons" are confined to a pretty small surface area, so don't expect the next *Final Fantasy* game to look quite that good. But it should be mighty close.



Most recent GPUs should be DX12-compatible.

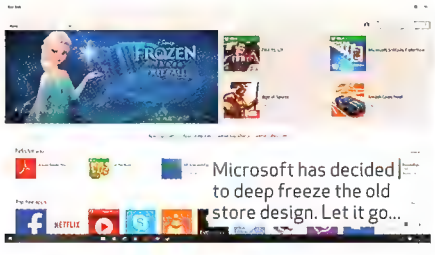
Raspberry Pi 2 micro computer and Intel Minnowboard Max, for example. Some specific tailoring had to be done to fit the OS on these tiny machines, resulting in a version of the OS earning the name Windows 10 IoT Core.

Microsoft's voice-based virtual assistant Cortana will serve up information based on how people search the web and how they use their PCs. The Cortana interface will also supply suggestions for new apps, based on what people search for. Cortana will also be able to interact with apps through just voice control.

STAYING SECURE

Running the world's most ubiquitous OS, Microsoft has always taken security seriously, often releasing patches daily to its various versions of Windows. Now, the company is looking to take its security measures to the next level, with two-factor authentication (2FA) becoming standard on enterprise versions of the OS. Microsoft also intends to protect user identities by storing user access tokens in a secure container that runs on top of Hyper-V technology, isolated from the rest of the OS. Windows 10 will also offer a data-loss prevention solution that will allow users to separate their corporate personae from their non-work ones.

The mobile version of Windows 10 will support Android and iOS apps.



Microsoft has decided to deep freeze the old store design. Let it go...

Getting Hands-on

WE TEST THE LATEST EARLY ACCESS VERSION OF WINDOWS 10.

So, how does Windows 10 actually perform when used on a day-to-day basis? Well, we've been part of the Windows Insider program, which has given people early access through various phases of the development. This review is based on version 10.0.10074 (build 10074) of the OS, which was released on 29 April.

The great news is that even in the pre-release builds we've been using, Windows 10 is fast and stable. There are some issues we've experienced along the way, of course, but these have either been ironed out or – as with some speed issues concerning the new Start menu and Cortana search bar – will surely be fixed for the final version. We hope. Anyway, here are the key features to get excited about.

THE NEW USER INTERFACE

People who skipped Windows 8 have nothing to fear – you'll feel right at home. In basic use, Windows 10 is not a million miles from Windows 7. You've still got the Start menu (though it's fundamentally changed) and key functions are all accessed from the Taskbar, which has a flat, functional feel. The design language feels refined – windows borders are smaller, for example – but the innovations are only subtle.

If you did immerse yourself in Windows 8, there's a little problem in that Charms have totally gone. Microsoft said they were the future. They aren't. All the former Charms functions are contained in a new Notifications Center, launched from the Taskbar and designed to match the Notifications setup in Windows Phone.

Previously a work in progress, the Notifications Center is now both usable and powerful. A raft of individual settings (called Quick Actions) includes standard stuff, such as toggling Bluetooth, Wi-Fi or Location on and off, but it's great to have. You can also get to Settings here, as an alternative to the Start menu, as well as switch into Tablet Mode. In the Settings app, you can select which Quick Actions appear in the Notifications Center, as well as which apps can send you Notifications.

START AGAIN

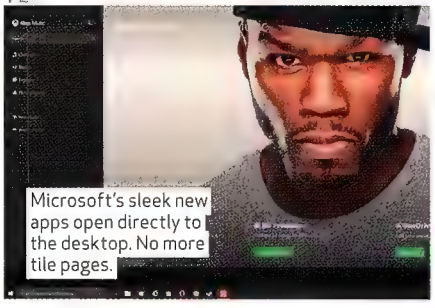
The Start menu is very Windows 8-like in that it features Live Tiles for at-a-glance information in apps. These were largely redundant for many Windows 8 users, mainly due to the lack of decent apps, but that seems very likely to change. It remains to be seen, however, how useful this can be. The remainder of the Start menu is much more like Windows 7, with controls for turning your PC off and restarting it, as well as most used apps and the ability to scroll down through all your apps in alphabetical order through an All Apps menu. File Explorer, Documents and Settings are also present.

The Start menu can be enlarged for touch devices, via a control in the top right, so it's more like the Windows 8 Start screen. It can also be resized to your taste. And, in case you were wondering, the Power User Menu is still there – just right-click on the Windows logo. Once again, you can minimise everything by clicking in the far right-hand corner of the Taskbar.

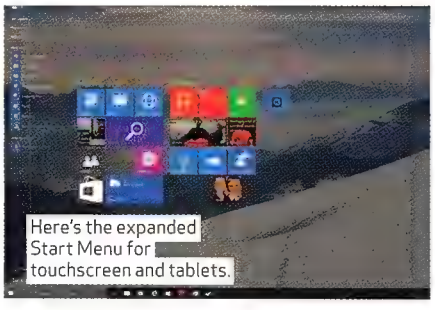
File Explorer has been given a little bit of a makeover. You now have a Quick Access area to which you can pin and unpin any folders you want to regularly access. In the 'home' screen of File Explorer you can also see Frequent Folders and Recent Files. It's much more helpful now.

APPS

Microsoft is going big on so-called Universal Apps – the company's great hope being that developers will



Microsoft's sleek new apps open directly to the desktop. No more tile pages.



Here's the expanded Start Menu for touchscreen and tablets.

Windows Update, not causing problems for once.

Big on details

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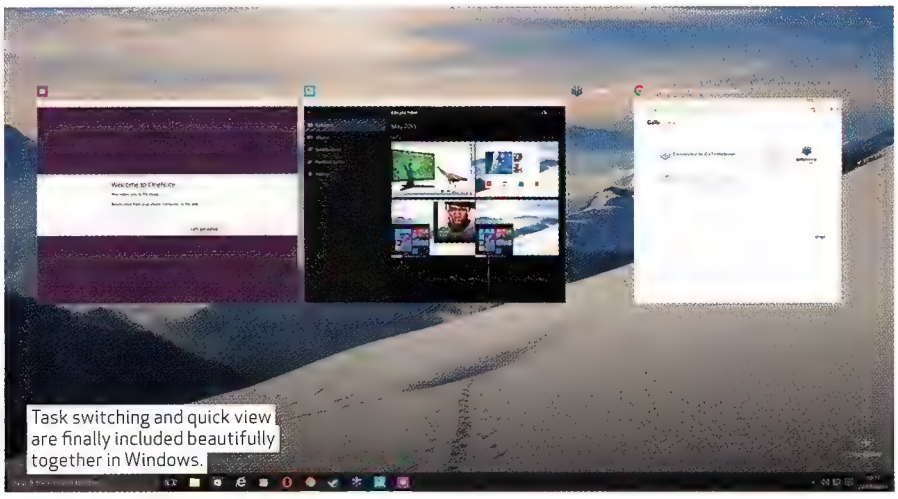
develop their apps once, to work across PC, Windows 10 on mobile and Xbox, too – essentially on every screen size. This is known as the Universal App Platform, or UAP. These are replacing what, in Windows 8 and 8.1, were known as Metro apps or Modern UI apps. They're different to desktop apps, but now co-exist with desktop apps on the desktop. They also have Live Tiles that live in the Start Menu.

Microsoft doesn't want to repeat the mistake it made with Windows 8 – assuming that developers will flock to the new OS – and so it's making it easy for developers to convert existing Android apps, while Microsoft Visual Studio 2015 now also supports Objective C (which is used to create iOS apps) and can compile it to Universal Apps.



Task switching and quick view are finally included beautifully together in Windows.

"People who skipped Windows 8 have nothing to fear – you'll feel right at home."

WINDOWS APP STORE

There's also a new Windows Store to come. This is still at the beta stage (in the Preview builds Microsoft has included the original Store as the beta doesn't function completely yet). As well as a revamped design, the new store will house desktop apps as well as Universal Apps.

Like Universal Apps, desktop apps installed from the Windows Store will be managed from there, so theoretically they'll install quickly (without you doing anything more than clicking once to download/install), they can be uninstalled without hassle and – crucially – they will be sandboxed from the rest of the system *à la* Universal Apps. Devs will use an Application Virtualization (App-V) container to package their desktop apps ready for the Windows Store.

Organisations will also be able to deploy apps from their own versions of the Windows Store. This is all managed from the Business Store Portal, which will manage software licences, centralised payment info and more.

We mentioned before about Universal Apps co-existing on the desktop – that's meant Microsoft has had to find

Going over the Edge

Microsoft Edge (previously codenamed Project Spartan) is the new browser for Windows 10, and it's actually functional already, so it's time to get judging.

Getting started, there's currently no way to move your Favourites and bookmarks from another browser, but expect that to change. The final browser will also include support for extensions, which developers can easily port from Chrome. Plus, Edge has a fancy new 'globe' logo, but that also feels distinctly unfinished.

Where Edge is impressing is in terms of raw performance. Pages render super quickly. Using Sunspider 1.0.2 to test JavaScript performance, Edge gave us a score of 201ms. This doesn't compare favourably with Internet Explorer 11, which scored 137ms. But it's better than Firefox 37 (260ms) and Chrome 43 Beta (303ms). Not too shabby considering it's far from the finished article.

Browsing still needs work, mind you — some more complex web sites don't work properly. While we could check Gmail, Hangouts wouldn't load. And when we tried connecting social accounts, it took three attempts to work.

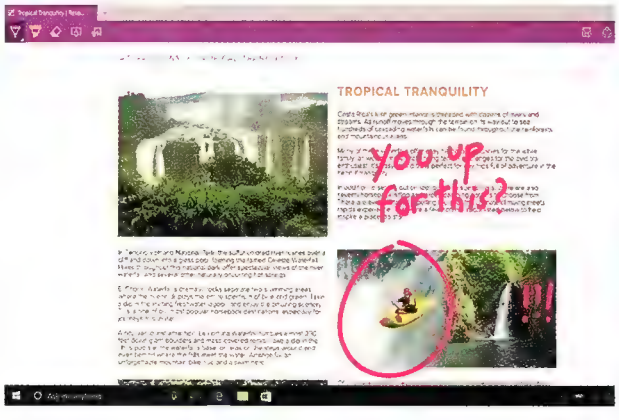
Many functions remain buggy. Typing in text fields can be laggy and some weird quirks exist, such as not being able to select the URL with a double-click in the address bar. Switching tabs was also a right pain, plus you can't rip tabs off at the moment. Some extra features are also absent, such as the ability to drag files into the browser (to attach them to an email or upload them to cloud storage).

Let's talk about the features that do work. You can find stuff and highlight specific words using 'Control-F'. Copy and paste works without issue. There's a built-in note-taking mode, so you can save and annotate webpages, plus a reading mode that strips away the content you don't need.

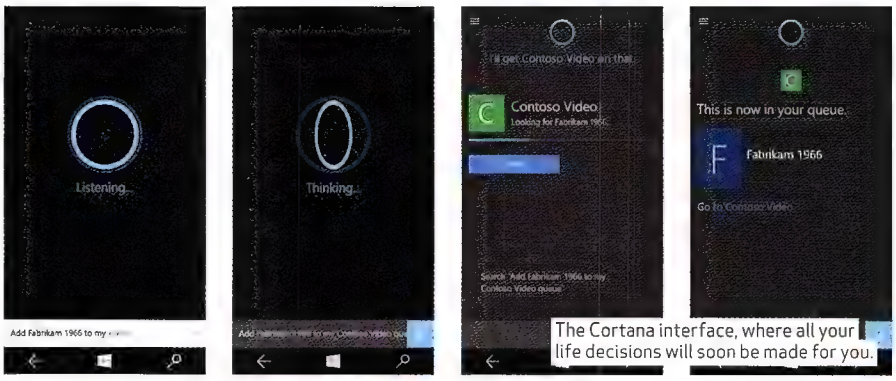
There's a download pop-up panel that you can instigate from a downloads pop-up, or by using a button on the title bar. Similar to IE, this panel can display History and Favourites, while another view displays your Reading List.

You're able to select anything and 'Ask Cortana' about what you've highlighted by right-clicking. This brings up a sidebar where search results appear. The Cortana integration will enable you to search and add info to your Cortana profile more seamlessly — this should be pretty useful.

If you asked us to sum up Edge in a few words, it'd be that browsing is OK, but there are very few bells and whistles.



PC Settings revamped ready for launch.



The Cortana interface, where all your life decisions will soon be made for you.

a new way to control them because the Windows 8 and 8.1 Charms are no more. This has meant a new menu bar in the top left, as well as standard minimise, maximise and close icons on the top right. These apps can now be resized however you want.

Thankfully, the quality of the built-in apps so far is way better. There's a new Photos app that provides you with a complete back catalogue, as well as editing and filter capabilities. Mail actually works now and has some useful features. Sport and News are improved experiences, even if they still feel a little on the superfluous side. Best of all, these apps all start up nice and quick, too.

TASK VIEW

There has always been 'Alt-Tab' – well, since Windows 3.x, anyway – to switch between open apps. But over the last two decades, Microsoft has regularly dabbled with various other methods, from the Taskbar (Windows 95), to Windows Flip (Vista), and swipe on Windows 8.

Now we have 'Alt-Tab' and a new thing called Task View. This takes you to an app overview where you can use your mouse to select the app you want. It's pretty clever – in any mode of Windows 10, there's always an icon for it on the Taskbar.

But there's something else Task View can do – multiple desktops. An icon in the bottom right enables you to add another desktop, so you can have one screen for your email perhaps and another for Photoshop. It's a nice new feature, but it's about time, considering it's been on Macs since 2009.

Apps can be open in more than one desktop, but you can't switch into windows that are on another desktop. Things are kept nicely separate. 'Alt-Tab' only works within the desktop you're in. The only way to switch desktops is to go into Task View and select another open desktop. From here you can also close desktops.

SETTINGS

If you used Settings in Windows 8 or 8.1, you'll know how half-arsed it was – you basically opened it, realised you couldn't do what you wanted, and went to the Control Panel.

Well, the Control Panel is still there in Windows 10. And if you're a technical user, you'll come across it from time to time – for example, to disable a network adaptor. But for most of us, you'll never see it. Settings is now a far more comprehensive solution, much more logically arranged. In early Windows 10 builds it still seemed unfinished, but pretty much everything you'll need is now there, separated into nine distinct areas. You can also search in Cortana for a setting, and you can search within the Settings app, too.

SEARCH AND CORTANA

Rather than being at the bottom of the Start menu as in Windows 7, Search now has its very own home on your Taskbar. That's because Cortana, Microsoft's virtual assistant, is incorporated and you can control it by voice.

Search, unfortunately, still needs a bit of work when it comes to finding things on your own PC. Microsoft is so keen to incorporate potential web

Windows as a service?

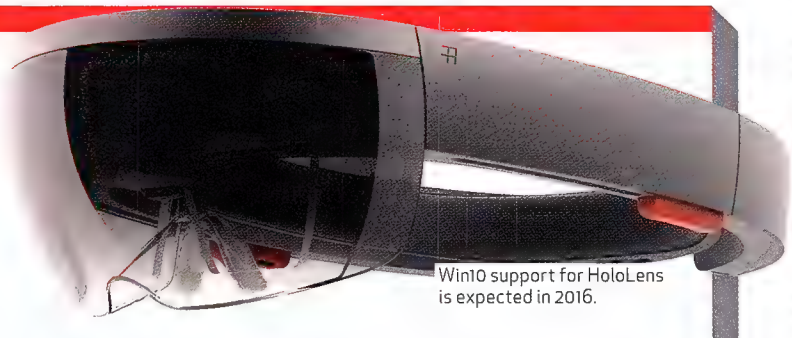
Microsoft revealed at the Ignite conference, at the beginning of May, that Windows 10 will be the last version of Windows. Before you reach for your digital 'the end of the world is nigh' placards, this doesn't mean Windows is going to disappear. Instead, Microsoft is working towards delivering the OS as a service. It's something it's talked about before, but it looks like it's finally confident enough to pull the trigger.

Instead of releasing an entirely new version of its desktop operating system every few years, Microsoft will take an Apple-like approach, delivering regular improvements through software updates.

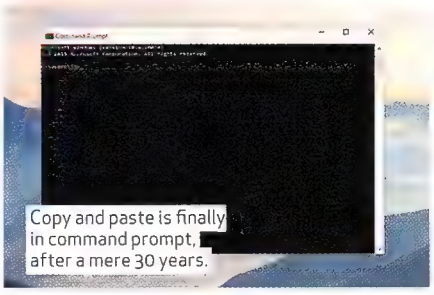
This could explain some of the vagueness of the release date. Maybe we won't have all the features we've been talking about at the release stage, but they will be added to the OS as time passes. Microsoft is making Windows 10 available as a free upgrade to all Windows 7, Windows 8 and Windows 8.1 users. It remains unclear, however, what sort of subscription pricing might be introduced down the line.

The Start menu and built-in apps are now unbundled from the main OS so users can get faster updates. Rather than waiting for a full Windows update, Microsoft is delivering smaller standalone app updates, a feature we're seeing in the Windows Insider Preview with the Mail and Calendar apps. This unbundling effect has allowed smartphone manufacturers to update core apps — such as the camera, photo gallery, mail and others — without having to wait for mobile operators to push out a larger OS-wide update.

Microsoft's next major update, codenamed Redstone, is expected to arrive in 2016, bringing Windows 10 support to more devices, such as HoloLens.

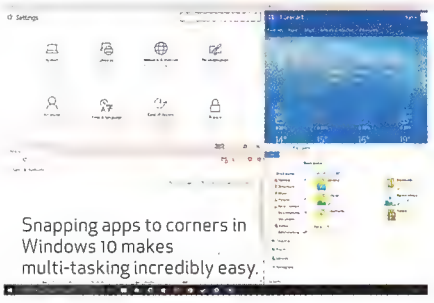


Win10 support for HoloLens is expected in 2016.

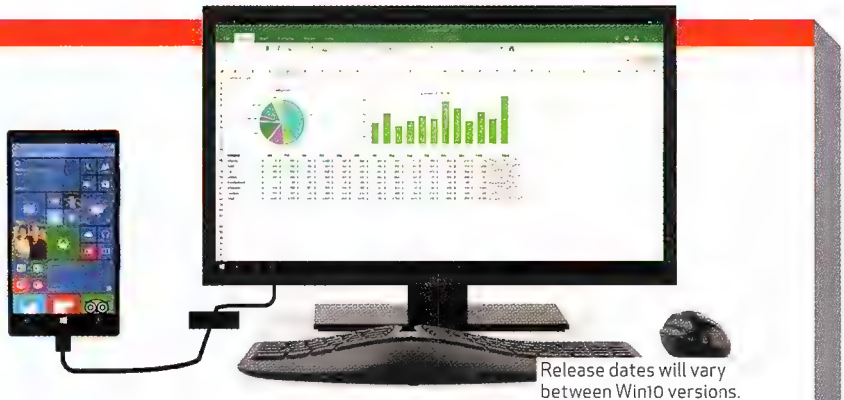


Copy and paste is finally in command prompt, after a mere 30 years.

Windows Backup makes it's triumphant return to the operating system.



Snapping apps to corners in Windows 10 makes multi-tasking incredibly easy.



Release dates will vary between Win10 versions.

The seven versions of Windows 10

Microsoft has confirmed seven different versions of Windows 10 will hit smartphones, PCs, tablets, HoloLens's and enterprise devices later this year.

Windows 10 Home is the main consumer desktop version designed for PCs, tablets and 2-in-1s. Xbox One owners will also be able to play full games on any Win10 PC upon its release. Windows 10 Pro, meanwhile, offers a higher level of control over PCs, tablets and 2-in-1s, and is geared towards small businesses.

Alongside these two sits Windows 10 Mobile for smartphones and smaller screen devices that will function in much the same way as its desktop sibling, thanks to the universal Windows apps used across Windows 10 Home and mobile editions.

Enterprise customers will see a dedicated Windows 10 version that builds on Windows 10 Pro with an even more advanced set of controls. Windows 10 Enterprise includes various features, such as the ability to use Windows Update for Business to manage the speed at which the new technology is adopted.

This is complemented by Windows 10 Mobile Enterprise, which brings a greater level of security and mobile device management and is flexible when it comes to updating employee mobile devices.

Lastly, Windows 10 Education is similar to Windows 10 Enterprise, except it's geared towards schools and promises paths for schools and students using Windows 10 Home or Pro devices to upgrade to this version.

Microsoft also confirmed there will be special versions for retail devices like ATMs, point-of-sale, handheld terminals, and industrial robotics. Windows 10 IoT Core will also be released at the same time.

searches into the Cortana results that often you need to click again to find a file on your PC – a 'search my stuff' option appears at the top of the menu.

This is especially the case when you're hunting for a generic file name, such as 'holiday'. As with previous versions of Windows, you can tap the Windows key and immediately start typing to search.

Cortana can display 'at a glance' information that's of interest to you, while you're able to create and view reminders, see stocks and much more, depending on how much input you give it.

Cortana is also being incorporated into Microsoft Edge, the new browser for Windows 10.

TABLET MODE

Microsoft is hoping a lot of tablets are sold in the coming years. Originally named Continuum, Windows 10's Tablet Mode is clever because it's automatic – detach the keyboard and the desktop prepares itself for touch, the Start menu becomes the Start screen, and apps appear full screen. The Taskbar also changes to be more touch-friendly – the icons are more spaced-out, while the pinned app icons don't appear at all – you just cycle through them in Task View.

If you want, you can toggle between Tablet Mode and non-Tablet Mode yourself via the settings at the bottom of the Notification Center.

AEROSNAP

One reason why Windows 7 was such a great OS was that it brought us something else – AeroSnap. The ability to snap windows to the sides of your screen might seem small, but it's something many Windows users use every day. Windows 8 got it a bit wrong, as Modern UI apps could only be snapped in certain ways, but Windows 8.1 improved on this.

Windows 10 gives us something else: four-way AeroSnap. You can have four applications in each corner of your desktop. If you've got a laptop screen, this is about the most inefficient way you could use your display, but if you've got a 27-inch panel, it might just be the ticket. In early builds, it worked as well as an umbrella in a Force 10 storm, but now it's pretty good. You'll get used to it quickly.

HELLO AND COMMAND PROMPT

New systems that ship with Windows 10 and support biometric security hardware will enable you to use a fingerprint, face scan or iris scan to log into Windows and apps, web sites and networks. This is called Windows Hello.

There's a new Command Prompt, too – small beer, you might say, but you're now able to properly select text and copy and paste in and out. 'Control-V' really will work. Text also re-flows as the window is resized.

EARLY VERDICT

Essentially, Windows 10 is still a work in progress. But as unfinished work goes, it's stunning. There are several reasons why we think it will be a success. There's the welcoming arms Microsoft is holding out to developers (if Microsoft can't make this work, it's a problem). Then there's the fact it will be a free download for consumers.

But above all, there's the fact it just works. If Windows 8 was the steepest learning curve imaginable, Windows 10 is like meeting a great friend you once knew, but they've bought some new clothes and you really do approve. ■

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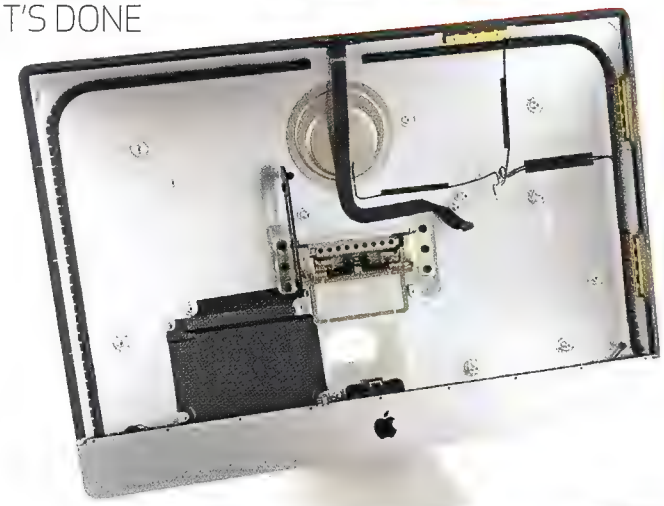
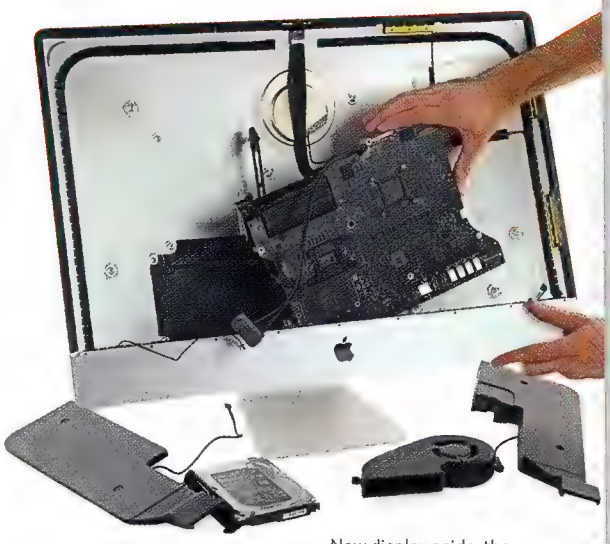
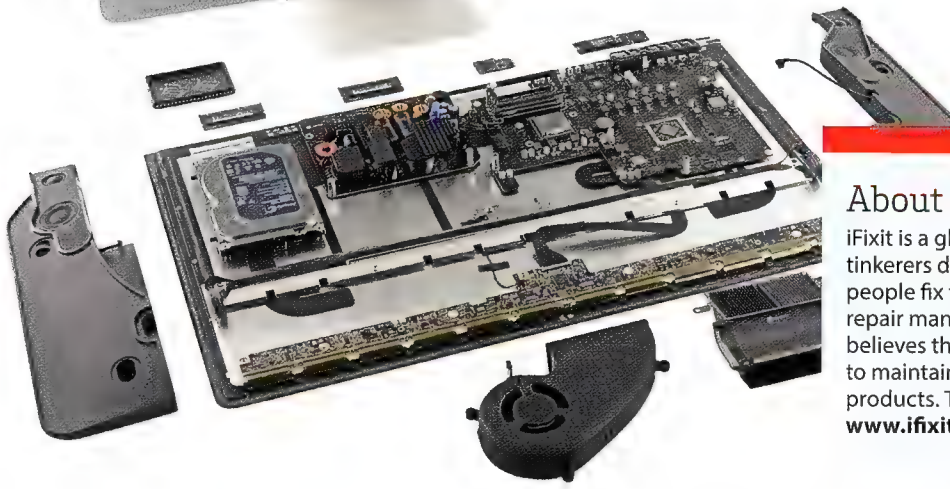




New display aside, the components inside the new iMac are pretty much identical to the previous model.



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iMac with Retina 5K Display

Its beauty isn't just skin deep — or is it?

BACKGROUND

The iMac may be the antithesis of what a computer is about for the vast majority of *APC* readers, but there's something cathartic about stripping down Apple's latest offering. Essentially this iMac is identical to the previous 27-inch offering, but with that Retina 5K squeezed in to offer up to four times as many pixels. Once you've torn it apart, what you're left with isn't quite so magical — it's all very straightforward.

MAJOR TECH SPECS

- 27-inch 5,120 x 2,880 IPS display
- Intel Core i5-4690 3.5GHz CPU (3.9GHz turbo)
- AMD Radeon R9 M290X 2GB GDDR5
- 8GB (2 x 4GB) DDR3 1,600MHz SO-DIMMs
- Headphone, SDXC, 4 x USB 3.0, 2 x Thunderbolt 2, RJ-45

KEY FINDINGS

- Apple has placed a memory slot panel on the rear, just above the power connector. You can easily add another pair of 4GB SO-DIMMs to take the overall capacity to 16GB.
- Popping open the iMac requires a special tool you squeeze into the gap behind the front bezel to ease the screen off. It isn't too difficult, but you'll need to replace the double-sided sticky tape when you piece the machine back together later.
- Disconnect the display ribbons and you'll be left holding the main selling point, the LG display. Lift the bottom bezel off to find the display logic, a long, thin board that extends the full width of the display. It's held in place with a couple of screws, which can easily be removed. Key components on the board are: Texas Instruments NH245 8-bit bus converter; Texas Instruments BUF16821 for gamma correction; timing controller from Parade Technologies DP665 (modified by Apple); power regulator from Texas Instruments TPS65270; and a Texas Instruments TPS65168 for TV LCD-displays.
- The rest of the chassis is almost identical to the previous generation, except the display ribbon has been widened to support the 5K display. The Intel processor can be found on the right-hand side of the mobo. You can upgrade the processor, as it isn't soldered to the motherboard.
- Storage depends on what option you've gone for — the iMac is available with just a hard drive, a combo of hard drive and SSD, or just an SSD. Here we've a 128GB SSD using a Marvell 88SS91383 controller connected through a PCIe interface.
- Repairability Score: 5 out of 10. The rear panel cover allows you to easily replace the RAM. You can replace the hard drive and processor, though that will mean cutting the tape to get inside. On the whole the components are modular, but the glass and display are integrated. Reassemby demands new double-sided tape.

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technotes

» EPINIONS

Have your Pi... A Raspberry Pi 2 can be a great low-cost computing option.

WASTEFUL UPGRADES

I enjoy keeping up with trends in technology. However, as I have been retired for a number of years and have to mind my 'pennies' somewhat, I have become aware of the tremendous waste involved in much modern technology. The focus seems to be on needing to have the latest (and thus most energy and economically wasteful) fad.

So, perhaps could I suggest you write an article on how to get a minimal computer/internet system for pensioners which uses little power and focuses only on email and simple web searches? Is such a system possible with Windows or must I turn to a Raspberry Pi (or is there a motherboard running a multi-core Atom that will do it)?

Also I get upset by two internet nasties – malware threats and spam. Why is it that nobody has worked out how to prevent malware using a hardware solution (e.g. have vital files in the operating system on a read-only SD card which gets copied to the main setup after each power-on)? Secondly, can I sue 'pushers' of advertising using my bandwidth? I have just visited a web site only to find advertising blasting me from my speakers. At least I should have been warned before being so 'taxed' by stealing my bandwidth.

Karl Tietze

Ed replies: The Raspberry Pi 2 will run Windows 10, so that may well be your best (and cheapest) option if you want a Windows-based system for simple PC duties... although we'd argue that Linux can stand-up just as well when it comes to email and web surfing, and would save you the price of a Windows license.

On your security question, there's always a trade-off between convenience and protection and the main problem with the kind of hardware solution you've suggested is flexibility: you can't make changes to that main 'system image' without then losing them at next boot up.

Regarding web advertising — no, you probably can't sue the publishers of it. If you're visiting a free web site (ie. one that doesn't use a paywall) then web ads are one of scant few options for that site to secure some income. Some web sites will actually let you subscribe to remove ads, but if you're browsing for free then ads are the actual price that you're paying.

FREE TO NOT BE...

I am aghast that Australia has taken to geo-blocking! Is this the country I came to, back in 1963, because I was escaping from political mayhem, killings and religious discrimination? That being the case, I sympathise with others who live in "democratic" countries such as ours and who share our freedom of choice and speech!

For those who are wondering what I am talking about, please type this URL into your browser and see where you end up: **www.popsci.com**. Better still download Tor (NSA's favourite browser), and type the same URL; not there yet?

Try **www.ultrasurf.us** and then try accessing the *Popular Science* magazine in the USA. I bet you can't reach anything other than **www.popsci.com.au**. YES, AU! It is really glorious to be free!

Would *APC* like to comment and free us from this yoke of "democracy"?

Nicolas Sampson

Ed replies: This looks like it's a case of what's called 'geo-targeting' rather than geoblocking. This is something that's done by the web site owner, rather than any nefarious government scheme. When the US site detects your location as being in Australia, you're being auto-forwarded to the AU version. We'll admit it does seem a bit more aggressive in its insistence on forwarding than most other sites, however we did find you can still get to the US version of the site using a VPN — you can try Hola Better Internet (hola.org) for an example, but be aware that Hola is a peer-to-peer service that may use your bandwidth to help other Hola users.

AUTO RIP OFFS

I have always read that automatic updates are recommended and should be left turned on. On a recent trip overseas I found that approximately 900MB of data got used on updates – this can only be updates since I did very little web browsing apart from checking email. Apart from the data usage the updates happen unexpectedly and freeze the computer at start up and shutdown.

While I appreciate the reasons behind the updates this is like buying a new car and changing the engine at every service.

In case you are wondering, yes I did turn off automatic updates but it keeps turning itself back on in both my Windows 7 and Windows 8 laptops. And now with Windows 10 being a SAAS there will be no choice.

Something not often appreciated by software companies or even technical writers is the cost of data these days (while travelling) and slow internet connections.

Satish Patel ■

APCMAG@FUTURENET.COM

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The Netflix Tax: is it fair?

Stephen Lambrechts is OK with overseas digital services being taxed, but only if we're given fair and unrestricted access to those services

For years, overseas digital services have been providing Australians with digital goods without having to charge the local goods and services tax. But with Netflix's arrival on our shores garnering huge amounts of attention, the loophole that allowed these companies to do so has been placed under much scrutiny from homegrown competitors – companies that have no choice but to charge GST. The hubbub has led to the introduction of a 'Netflix Tax' – an amendment to the current Goods and Services Tax legislation that will extend the GST "to digital products and other services imported by consumers," which covers practically any digital commodity from a company abroad that can be purchased online. Movies, TV shows, music, ebooks, streaming services and even downloadable video games from services such as Steam will be taxed.

The reasoning behind this is simple – it's unfair that local business must be forced to charge GST for their digital goods while overseas companies can sell in Australia without having to pay tax. For starters, the goods these overseas companies sell don't stimulate our economy, and for the most part, they don't provide Australians with any jobs. While we're not thrilled about having to pay GST on these digital items, we can say that it is absolutely fair – though not while Australians continue to be forced behind geoblocks. Recent reports have suggested that the Australian government is considering a ban on VPN services, which would most certainly force consumers to suffer price discrimination.

Consumers need to be allowed to hunt around for the best deals online, without having to suffer region-based price gouging. It's not uncommon for Australians to pay almost twice as much as other territories for video games and other forms of software. Why? Because other options are rarely available to them. Steam largely allows Australians to purchase downloadable PC games at the same prices charged to American gamers (with a few notable exceptions), but if you're looking to purchase a game on the Xbox Store, you'll have to buy it locally and it can cost you upwards of $100 for a game that's been out for years.

The European Commission has spoken out against these practices recently, stating that "too many Europeans cannot use online services that are available in other EU countries, often without any justification; or they are re-routed to a local store with different prices," and we couldn't agree with them more. Not so long ago, it seemed that Australia thought that way, too.

Back in 2013, the federal parliament recommended that Australian businesses and consumers be informed on how to lawfully bypass online geoblocks to avoid local price-gouging on IT products. It even suggested that an outright ban on geoblocking be considered. Unfortunately, the suggestions in that report have yet to eventuate, and things seem to be heading toward darker territory for Aussie consumers. The Australian Government is part of an upcoming free-trade agreement with several other countries – the Trans Pacific Partnership – that could see stronger laws in favour of geoblocking introduced.

The end result could be that we're getting the raw end of the stick twice. It's all well and good to ask overseas companies to charge GST, but 'levelling the playing field' is a two way street. If the government is going to force Australian consumers to pay the GST, then it should also make region-based price hikes illegal. ■

ENDUSER

Share your stories!

If you have an iteresting story about technology users, their experiences and the issues that affect us all (whether funny or serious), email us at **apcmag@futurenet.com**. All correspondence becomes the property of *APC* and is subject to editing. Letters must include writer's full name, street address, suburb, state and phone number to be considered for print publication. Address and phone details will not be published.

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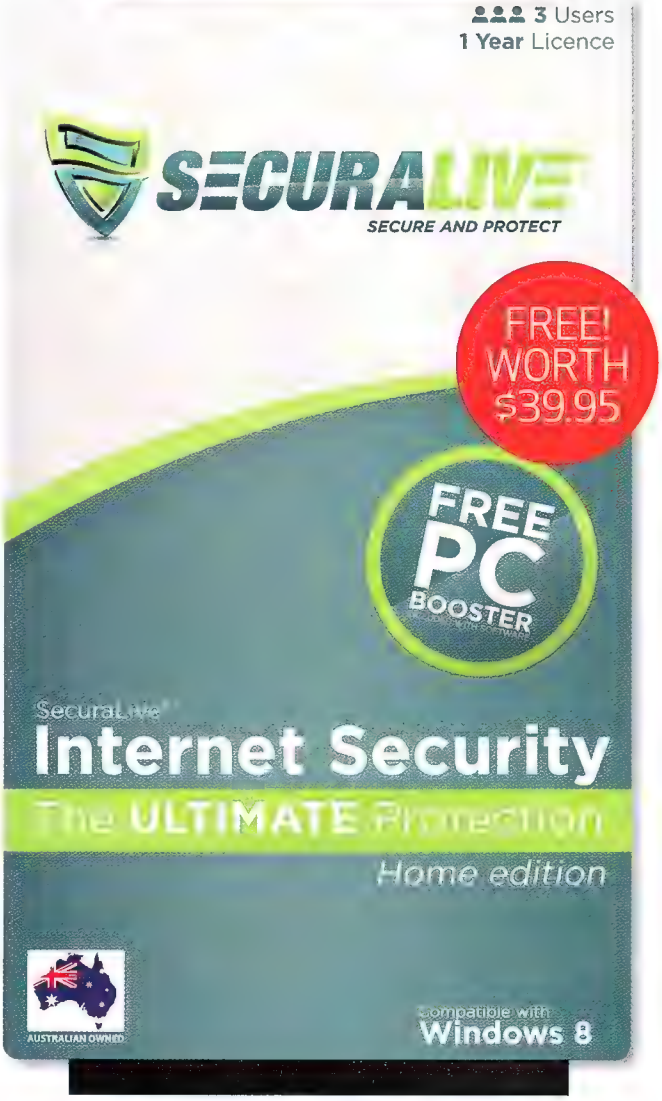

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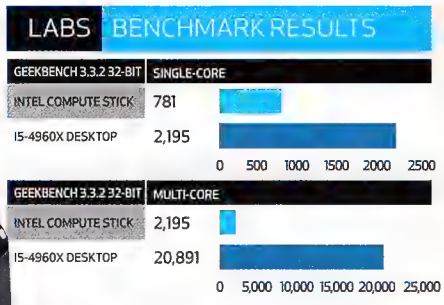

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Intel Compute Stick STK1A32WFC

An impressive first step for ultra-small PCs.

When Intel announced the Compute Stick, in January we were pretty excited. Sure, there's a handful of devices already on the market that get content onto your TV, but Intel's Compute Stick is a full-fledged x86 Windows 8.1 PC. And that makes a big difference.

On the outside, it's minimalistic in design. It's slender and black and has slits for intake and a small fan that exhausts hot air. The fan isn't loud by any measure, but does emit a high-pitched whine. On one side of the Compute Stick is a micro-USB port for charging, and a regular USB 2.0 port for accessories like a keyboard and mouse. The opposite side has a MicroSD slot, if you feel 32GB is too claustrophobic. For light computing duties, we didn't feel the need to upgrade.

Plug the Compute Stick into a TV's HDMI input, or a normal desktop display, and you're good to go. We opted for a 24-inch Dell LCD panel. Internet connectivity is handled by 802.11bgn. Unfortunately, no 802.11ac support is integrated, and the onboard Wi-Fi is only single-channel 2.5GHz, with no 5GHz support.

On booting, we went through the normal Windows 8.1 setup. Once finished, we landed on the desktop. It felt like a normal PC. After all the Windows updates were installed, we loaded our usual array of apps and once Steam was installed, the Compute Stick became another beast entirely.

Valve enabled Steam In-Home Streaming a while ago, and we realized that the Compute Stick would be a pretty great solution. We tested *Ori and the Blind Forest*, *Grand Theft Auto V*, and *Dota 2*. All games played without fail through Steam In-Home Streaming, and felt like we were playing on an actual desktop. We then attempted to play games natively, but that was a futile exercise. Even Valve's original *Portal* was a miserable experience. Streaming is where the Compute Stick really excels.

Aside from streaming, performance was relatively good. However, with four or more casual applications open, you start to feel the effect of having only 2GB of RAM and limited CPU power. Chrome tab refreshes start to lag. General performance is on par with a netbook.

We ran some basic benchmarks, since it can't really handle our usual array of desktop-class tests. For reference, we included numbers from an Intel Core i7-4960X desktop with 8GB of RAM (thus showcasing a David versus Goliath scenario).

The Compute Stick just isn't meant for heavy-duty PC chores or native gaming. It's meant for casual work or content consumption and entertainment. For all intents and purposes though, that's fine. Gamers who are looking for a lightweight streaming solution should give the Compute Stick a serious look.

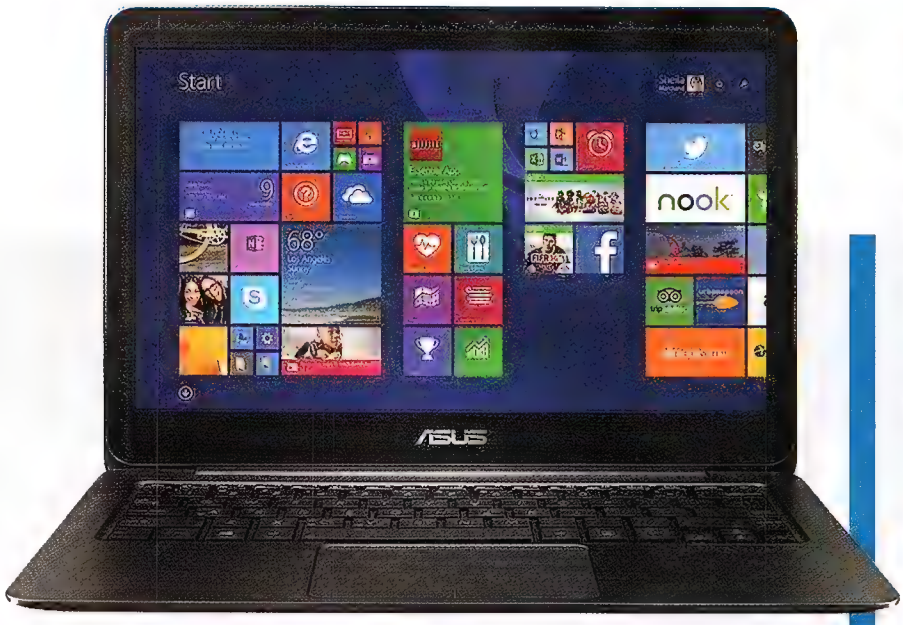
There's a lot of promise in this platform. Consider this iteration a step in the right direction. There will be a day when a device such as this will be able to hold its own as a full-fledged HTPC. If you're looking for a powerful solution, though, today is not that day. ■ **Tuan Nguyen**

Verdict

Features	★★★½
Performance	★★★
Value	★★★★½

It's a full-fledged Windows 8.1 PC; ultra-small; does Steam In-Home Streaming well.

★★★½



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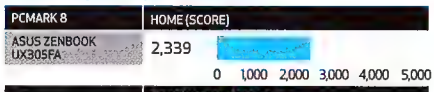
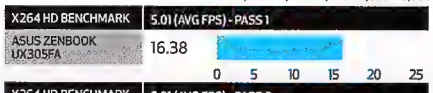
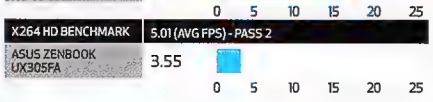
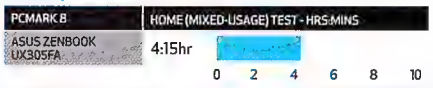


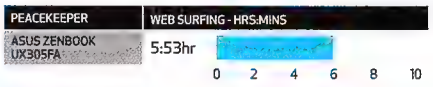




Gaming performance*

Battery life





ASUS ZenBook UX305FA

Is ASUS's latest wallet-friendly ultrabook yet another win, or a missed opportunity?

Back in the Christmas issue of our sister publication *TechLife*, we gave a stellar review to ASUS's ZenBook UX303LN and so, naturally, we were expecting big things from this sort-of follow-up, the UX305.

Wrapped in a shiny black stainless steel chassis with a matching matte metal screen-trim and keyboard-surround, there's a lot to appreciate in this new, more sedate exterior design.

What's still clear is just how portable this ZenBook is, with its 12.3mm girth and a 1.2kg total weight, the UX305 looks and feels like an impressively-built Windows counterpart to the MacBook Air.

But peer a little harder and that initial impression doesn't quite hold up. See, the UX305 is packing one of Intel's latest range of Core M processors, specifically the 1.2GHz dual-core M-5Y71. Apple's used the same type of Core M chips in its new petite 12-inch MacBooks, but the problem with the 13-inch ZenBook UX305 is one of size: this is much bigger than Apple's new MacBook, and shaving off a few millimeters of thinness from previous ZenBooks doesn't really make sense when it comes at the cost of processing power.

Of course, the UX305FA will surf the web and has ample grunt to run office apps like Excel and Word, and even do some light image editing. But in some senses that 'laptop' appearance is a bit deceptive, particularly when it comes to gaming performance. The older UX303LN, with its Nvidia GPU, is about four times faster in this area.

The ZenBook UX305 does have some redeeming features, however. The chiclet keyboard is definitely a step up from the average, with stable and tall keys that feel great to type on, and although the trackpad does occasionally feel as though you're dragging your finger through mud, it's mostly manageable.

The screen is a little mixed. Although it's a full HD 1080p IPS number – with nice rich, full colours – the matte anti-glare coating does add quite a bit of sparkle to images, especially when displaying lighter colours.

Six hours of battery life when web surfing isn't bad either – although to put that in broader perspective, that's around half what a 13-inch MacBook Air, running Apple's OS X, manages to achieve. Clearly, the Apple OS has some advantages when it comes to low-power tasks.

And while the UX305 is one of the thinnest laptops on the market, but when you consider that its performance is a little behind a two-year old 2013 MacBook Air (which you can pick up refurbished for under a grand) the ZenBook's street price of $1,299 is a little harder to justify.

As it is, we'd recommend forking out a few extra hundred for the more versatile UX303LN; it's a better all-rounder that can even manage some light gaming... at the expense of some battery life, of course.

Joel Burgess

Verdict

Features ★★★½☆
Performance ★★★☆☆
Value ★★★½☆

It's thin and light, but is lacking a little in performance when compared to its UX303LN predecessor.

★★★½☆

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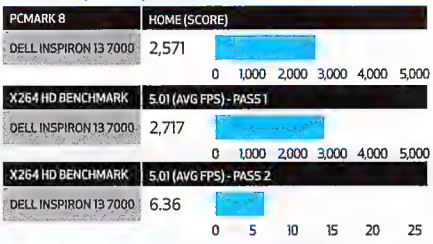
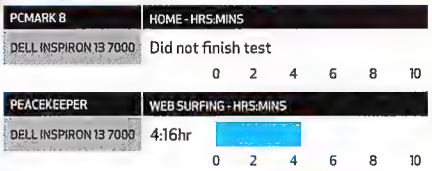
LABS BENCHMARK RESULTS

General system performance



Gaming performance*

Battery life



Dell Inspiron 13 7000 Series 2-in-1

One stylish laptop-tablet hybrid at a rather keen price.

Dell's new 13.3-inch 2-in-1 is the laptop/tablet hybrid that wants you to have it all. It's able to operate as a well-featured ultraportable notebook (including a rather MacBook-like silver colour scheme – although here it's plastic rather than aluminium) and comes stocked with three USB ports (two 3.0), a full-sized HDMI out, SD card reader and a 3.5mm headset socket.

Flip the screen around, though, and you have a sizeable business tablet, including stylus, for tasks where you'd rather use touch. This top-spec model also packs speedy parts inside: a dual-core 2.4GHz Core i7 CPU, 256GB Samsung SSD and 8GB of memory. This'll handle day-to-day tasks with aplomb, and can even handle a little photo and video editing on the side. It's only really gaming where you'll notice any slowness – here, the Intel HD Graphics 5500 chip can't really handle anything more than casual play. Battery life is likewise just average: about 4:15hr when web surfing.

There's some good overall design on display here though, such as the elegant and straightforward hinge mechanism that means switching from laptop to tablet modes is quite stable and smooth, and the glossy, soft-touch plastic finish on the chassis makes for a classy feel in the hand. The backlit chiclet keyboard and large trackpad are both first-rate, closely resembling what you'll get with Apple's class-leading MacBooks.

That said, this is a bigger 2-in-1 than we often see, with that 1080p 13.3-inch display surrounded by medium- to large-sized bezels, which all add to the overall footprint – the bezel below the screen is a good 3.5cm, for example. Still, it's reasonably portable at 1.6kg, and the charger is likewise quite a compact little job. That said, we wouldn't want to have to hold this 2-in-1 one-handed while in tablet mode for more than a minute or two.

The aforementioned included stylus is a bit underwhelming in places, sadly. Rather than the fine-tipped stylus that you'll get with Microsoft's Surfaces, this one has a rubbery nib about the size of a matchstick head. While it gets the job done, it's not quite as precise or stable to write with – although it can at least be safely stashed inside the Inspiron, thanks to a slot on the right-side of the base.

With the Core i7 processor, Dell's had to outfit this one with an exhaust fan in the back behind the keyboard, although it's thankfully reasonably quiet in operation.

That price is quite reasonable too, and if you can't stretch to this high-end model, there's an entry-level alternative for a rather affordable $999; you'll have to put up with a lower-res screen and a Core i5 processor at that price point though.

All up, this is a very attractive 2-in-1 and while it could be better in a few places, it gets a lot more right than it does wrong. A good-value offering at a fair price.

Dan Gardiner

Verdict

Features ★★★★
Performance ★★★★
Value ★★★★

Although it could be better in a few places, this is a stylish and smooth 2-in-1 at a nice price.

★★★★

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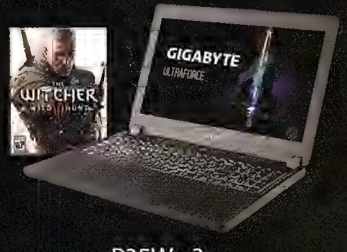

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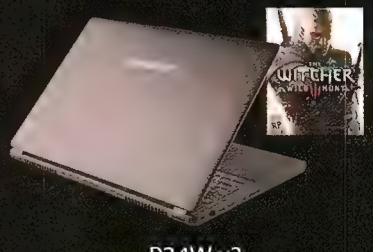

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GAMING MONITOR

$699 | WWW.ACER.COM.AU

Acer Predator XG270HU

Our first FreeSync monitor touches down, but can it give the pricey ASUS RoG Swift PG278Q a run for its money?

Acer's new XG270HU is the first monitor we've tested that offers AMD's frame-syncing technology, FreeSync. It's a high-end, high refresh rate panel that ought to deliver the best possible FreeSync experience at a fraction of the cost of something like ASUS's range-topping PG278Q screen.

So how does FreeSync differ from G-Sync? Essentially it's a technology that leverages the Adaptive Sync part of the DisplayPort 1.2a protocol to enable AMD graphics cards to speak to compatible monitors and display frames from the GPU when they're ready.

Conversely, Nvidia's G-Sync requires the monitor manufacturers to license the G-Sync tech and install a specific hardware module in their displays, to sync with GeForce GPUs. AMD's use of the established DisplayPort 1.2a Adaptive Sync protocols means it needs no new hardware nor any licenses; it's, y'know, 'free syncing'.

Initially, we thought the Acer had grabbed the same AU Optronics panel the Asus Swift is using and, given that it's up to $300 cheaper, that would be a major feather in the cap for both Acer and AMD's FreeSync initiative. A quick specs check would seem to corroborate that initial thought – both are native 2,560 x 1,440 panels using TN tech with a 1ms response time at a 144Hz refresh rate. But there's one key spec that separates the two. The Swift is a true 8-bit screen while the Predator reportedly uses Frame Rate Control (FRC) to enhance its 6-bit monitor.

Putting the monitors cheek-by-jowl, you can see they're most definitely not the same. Aside from possibly a slightly improved viewing angle for the Acer panel, it loses out to the Swift in terms of image quality. Sometimes only by a touch, but sometimes by a wider margin. The contrast and gradients on the Acer are only slightly behind the expensive ASUS monitor, but it's a long way behind when it comes to the black reproduction. It's also not so hot on the whites either, but both being TN panels, neither are exactly paragons in that regard.

The addition of the G-Sync license and hardware isn't the only reason the Swift is more expensive. The Acer is just making do with a limited tilt stand – there's no height adjustment, a bit of a miss with TN's paucity of vertical viewing angles.

There's also a noticeable amount of ghosting on the panel when you're using FreeSync too, something Nvidia claims isn't present with G-Sync panels because its hardware is set up specifically for each panel to operate optimally. With FreeSync, AMD says it's up to the panel manufacturers to ensure dynamic refresh rates and pixel persistence is tuned for each screen.

Our first experience of FreeSync isn't brilliant, then. But it wasn't with G-Sync, either. This is a new technology so the early screens aren't going to be perfect, and the Predator most certainly isn't that. At $700 it's also not really toeing the line that FreeSync isn't adding a price premium – you can pick up a 27-inch IPS 1440p panel for around $200 less. Still though, FreeSync is great if you're already running an AMD GPU. Games run much smoother than with V-Sync, and this Acer panel doesn't need any messing about to get that running. We do still baulk at this price for a TN screen, though, especially when IPS or MVA Adaptive Sync capable screens are on their way. ■ **Dave James**

Verdict

Features	★★★
Performance	★★★½
Value	★★★½

Easy FreeSync; high refresh rate; cheaper than the Swift; still needs some tweaking and optimising.

★★★½

MONITOR

$799 | GAMING.BENQ.COM

BenQ XL2730Z

A big screen offering adaptive refresh on the cheap… ish.

Buttery smooth gaming goodness. Yum. Don't ya just love it? We speak, of course, of slick, stutter-free frame rates. Not a new line of tasty comestibles available from Steam. Anyway, achieving true gaming smoothness demands quite a financial commitment these days.

To the traditional CPU-GPU tag team, we must now add a monitor capable of 120Hz-plus refresh rates (144Hz has become a 'thing', live with it). Oh, and ideally some kind of adaptive-syncing technology to get your graphics card and screen working as one. That's how you eliminate the very last vestiges of microstutter, screen tearing and all that bad stuff.

Question is, how much are you willing to pay to achieve that? The arrival of BenQ's new XL2730Z gaming panel has certainly got us thinking. It's yours for around $800. That's one hell of an entry fee, especially for a TN screen. Yup, this monitor makes do with plain old TN tech. Except, as we've learned with the new generation of 4K monitors, TN isn't the dirty word it used to be when it comes to basic image quality. More on that in a moment.

What's more, this is a 27-inch, 1440p screen. That means 2,560 x 1,440 pixels and arguably the sweet spot right now in terms of trading off visual detail and sharpness against playability. The much higher 4K resolution (3,840 x 2,160 pixels) can indeed be glorious. But it also batters just about any graphics subsystem to a quivering, bloody pulp.

Next up is the high-refresh and frame-syncing shizzle. The 144Hz bit is predictable enough. More of a twist is support for AMD's FreeSync as opposed to Nvidia's G-Sync. For better or worse, adaptive-refresh tech is bifurcated by graphics vendor, for now.

Anyway, FreeSync is a welcome and intriguing alternative to G-Sync. Its most obvious advantage is cheapness. And this BenQ is indeed around $250 cheaper than its most obvious G-Sync'ed rival, the ASUS RoG Swift PG278Q. At $800, however, it's a million miles away from actually being a cheap monitor.

PARANORMAL ACTIVITY

All of that, however, is very probably moot as things currently stand. That's because AMD's FreeSync tech isn't truly ready for public consumption. For starters, this BenQ screen suffers from the same ghosting problem by which all FreeSync screens seem to be blighted at the moment. It's down to the fact that enabling FreeSync currently disables or bypasses the overdrive tech that's so critical to improving pixel response.

Apparently a fix is coming in the FreeSync software. But it will also require a firmware update for any relevant monitor. It's all a bit complicated and not the sort of thing we're comfortable taking on faith. We need to see it fixed before recommending FreeSync and any screen thusly equipped. As it happens, the XL2730Z is also a classic TN panel in the bad sense – it lacks vibrancy and the viewing angles are meh. That's just like the ASUS RoG Swift, with which it probably shares its panel. The fact that it's a little more flexible than the RoG thanks to a greater array of inputs, therefore, probably isn't enough to make the BenQ XL2730Z terribly compelling. Next!

Jeremy Laird

Verdict

Features	★★★
Performance	★★★★
Value	★★★★½

Huge overall spec; perfect resolution for high-end gaming; welcome alternative to Nvidia G-Sync tech.

★★★½

SSD

$375 | WWW.OCZ.COM

OCZ Vector 180 480GB

Is it time for an SSD upgrade?

The Vector 180 uses Toshiba A19nm MLC NAND, coupled up to OCZ's own Barefoot 3 M00 controller which runs at 397MHz. It's also got a power failure management feature that can finish writing before shutting down, helping avoid data loss or drive failures. While not exactly a common occurrence, it gives some extra peace of mind.

In the package you get a packet of screws as well as a 2.5- to 3.5-inch mounting adaptor to make installing the drive easy in a desktop. You also get a license for Acronis True image, which is a handy bit of software for cloning your existing HDD. For laptop use, the SSD is only 7mm thick, so will still fit in low profile slots.

We tested with AS SSD and achieved a decent but not stunning 492.27MB/s read and a 481.69MB/s write speed. To put that in comparison, the Vector 180 is edged out by the similarly priced Samsung 850 Pro.

The Vector 180 comes with a 5 year warranty, and is rated at 50GB of data writing a day. While plenty for normal use, it's nothing special compared to the competition and a bit low for a large-capacity SSD. The Vector 180 also lacks support for low power slumber states so it's perhaps not a good choice for use in a laptop.

The Vector 180 comes in 120GB, 240GB, 480GB and 960GB flavours, and in true bulk-buying, the value for money gets better for the larger drives.

Lindsay Handmer

Verdict

Offers decent performance, but not ideal for laptops, or those who write a lot of data.

★★★½

CASE

$170 | WWW.PHANTEKS.COM

Phanteks Enthoo Evolv Micro Tower

A large case... for small builds?

The Enthoo Evolv has been created to hold either microATX or mini-ITX boards and for a micro tower, it looks like it's been at the steroid jar, which somewhat begs the question – why only support the two smaller motherboard formats?

Still, the build quality is undeniably superb, as is the choice of materials; steel frame and good quality anodised aluminium. But don't pick up the case using the front and rear edges of the top panel – the clips don't hold it in very firmly.

The power buttons and I/O panel are in an awkward place, sitting on the back side panel, meaning you have to grope around the rear of the case to get to the power or reset buttons, never mind the two USB 3.0 and two audio ports.

You have a few options to install hard drives. A vertically mounted pre-drilled plate held in by screws support a single 3.5- or two 2.5-inch drives. Around the other side is a drive cage with two bays that support 3.5- and 2.5-inch drives. On the rear of the motherboard-mounting plate, there are mounts for another pair of 2.5-inch drives.

It comes with a 200mm front-mounted fan and a 140mm on the rear panel. The front 200mm fan can be replaced by a pair of 140mm and the roof has mounts for two 140mm or three 120mm units. There is also a PWM fan hub installed, which controls 11 three-pin fans. If you're liquid cooling, it supports a 240mm radiator, but this limits the length of graphics card that you can use, while a 240/280mm rad can be installed in the roof.

Simon Crisp

Verdict

Superb build quality; modular drive options; pre-drilled mounts for DIY liquid cooling components.

★★★★

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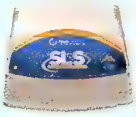

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GAMING HEADSET

$269 | WWW.ROCCAT.ORG

Roccat Kave XTD 5.1 Analog

Gather round children, this is what we did before USB.

This must be the headset equivalent of vinyl. Sought after by those who think moustaches are ironic, and hoarded in specially varnished and levelled Ikea bookcases. They're listened to in an acoustically dead room using gold-plated Ethernet cables as interconnects.

Or maybe, just maybe, an analogue connection is an excellent way to get true surround sound out to a pair of headphones without resorting to the Dolby Headphone virtual trickery employed by a number of recent headsets. The Kave features a pair of 40mm drivers and a 30mm for bass in each earcup – this is genuine surround sound.

It's a bit of a fiddle to install. You may have forgotten about the phono jacks most motherboards still carry as part of their built-in sound hardware. They sit, overlooked, on the back of many PCs, and in ours we had to swap over a plug on the mobo's audio header before they'd even function, thanks to a front-mounted headphone socket. You'll need to activate 5.1 in your soundcard drivers too, and turn up the master volume. There's a USB connection too, for power.

The cable then runs up to the inline remote. Which is enormous. It's a five-way volume control and mode switcher, and there's a clip on the back to attach it to your shirt, but really, it's best left desk-mounted.

Continue up the cable and you get to the 'phones themselves. The noise-cancelling microphone arm is detachable, but sweeps out of the way inconspicuously. The earcups have been padded, but not nearly enough for our sensitive lugholes. We found them uncomfortable to wear for even short periods of time.

"Hand-sewn leatherette cushions," it says on the box. They may be that, but we tried shifting them around, adjusting the headband and pushing them onto the back of our head (which ruins the surround-sound effect), yet nothing would make them more comfortable to wear.

To be completely fair to Roccat, they do get more comfortable the more you wear them. First impressions count, however. Whether their hardness is an inevitable consequence of packing multiple drivers into a pair of headphones or of Roccat employing the Marquis de Sade as a designer we're not sure, but no matter how good the sound, you're not going to enjoy using this headset if it feels like your ears are about to swap positions by being driven through the centre of your skull.

The audio quality is genuinely very good. The sound is nicely isolated from external distractions, the bass is thick as long as you turn it up and the surround sound works, though not as well as real speakers. Noises behind the camera in a game sound pretty much like they're behind you, and we couldn't say that of the last Dolby Headphone headset we used, which mushed all the sounds together into a central trench.

For the same kind of price you could get a Sennheiser Dolby Headphone unit or a cheaper Logitech G430 or Corsair Gaming H1500 (both also virtual). But analogue surround sound headsets like this are very few and far between on the market, and so if the positional sound quality is important to you – and you have ears made of roofing felt – this is surely the headset to go for. Otherwise, get a more comfortable one.

Ian Evenden

Verdict

Features	★★★
Performance	★★★½
Value	★★★

Genuine surround sound; great audio quality; impressive inline remote — if only they didn't squash your head.

★★★

GAMING MOUSE

$89 | WWW.TURTLEBEACH.COM

Turtle Beach Grip 500

Like a kitten in your hand, but no pussycat when you get gaming.

Turtle Beach is really onto something with the soft coating it's dipped the Grip 500 in. It feels like the firmest marshmallow.

The mouse has seven buttons, all programmable with commands or macro sequences but not really suitable for left-handers. You can click the main buttons all the way back at the mouse's mid-point, useful should you have particularly short fingers.

The body of the mouse is broad, sitting high in the palm, while a tapered shape accommodates claw grippers. Button layout is nicely thought-out, as long as you're prepared to use your thumb, with a good amount of travel once pressed.

The main switches are Omrons, the ubiquitous choice of the gaming mouse, and the infrared garnet eye of an Avago laser sensor gleams invisibly underneath. There are grilles either side of the cable to make the mouse look like a sports car, and the lighting can be adjusted with an app on the PC along with the button programming. Five colour-coded profiles can be added to the mouse's onboard memory, and switched between on the fly. The wheel, where so many mice fall down, is nicely notched and sports a grippy tyre. It feels very light however, putting up barely enough resistance to being spun. We'd have liked to see a bit more presence and weight to it. It can be assigned different functions using the PC app, though we lack the imagination to think of too many situations in which it would actually be useful.

The soft-touch coating could, unfortunately, prove to be the Grip 500's major drawback. If you're sweaty, the mouse is going to get quite slippery, the problem being that there are no ridges to hold your fingers on the buttons or grippy textures on the body. Come down from the buttons too hard and you risk sliding off and thumbplanting the desk.

There's also the price. For $50 you can get a Razer DeathAdder or Logitech G502, either of which is a more satisfying mouse to use than Turtle Beach's otherwise commendable, comfortable effort.

■ Ian Evenden

Verdict

Lovely soft finish; decent buttons; customisable.

★★★☆☆

apc RECOMMENDS

GAMING KEYBOARD

$169 | WWW.TURTLEBEACH.COM

Turtle Beach Impact 500

The Tyrion Lannister of the mechanical keyboard world.

The Impact 500 is a mechanical keyboard with the number pad amputated.

The soft coating we waxed lyrical about on the Grip 500 mouse opposite is present and makes a bit more sense on a keyboard. It's still gorgeous, but the keys here are smooth-topped rather than rubber-coated and feature the kind of contouring that the mouse was so sorely lacking. Even the sweatiest finger will have a hard time falling off. Cherry Blue switches lurk beneath the keys, with a click that activates quite high up in the button's travel. It is, as we've come to expect, a positive action – there's no doubt whether you've pressed a key or not – and there's plenty of travel once you've pressed it. Whether you allow the key to bottom out or snap your finger straight back up again, it'll still register. There's six-key rollover with anti-ghosting (you can press six at once and it can distinguish them) for those finger-twisting combos.

There's even a removable mini-USB cable (that's nicely braided) so you can make a swift escape from a player more skilled at insults than you are.

The steel-reinforced frame means it's a sturdy unit, its compact dimensions adding even more stiffness than a wider chassis would. There's some decent feet, meaning it sticks gecko-like to your desk as you thrash from side to side. What you don't get are any programmable macro keys (boo) or ridiculous lighting systems (yay), which means there's no application or special drivers to install before you can use it.

A Function button next to the right Alt key gives access to media controls found on the central F keys, and an indicator lamp on the F9 key lets you know when the Windows key lock is engaged, but that's about as complicated as it gets.

Unless you really need a numberpad, this is a great mechanical keyboard. It may lack bells and whistles, but its build quality is excellent, it does the fundamentals well and it's a joy to use in a keyboard-intensive game. It's only a little less than Corsair's K65 RGB though. How much do you like the coloured lights? ■ Ian Evenden

Verdict

Great build quality; lovely to use; nice clicky action.

★★★★☆

software

» APPS FOR ALL THE PLATFORMS

Windows SOFTWARE

Adobe Photoshop Lightroom 6

Adobe's photo enhancer gets a fresh new update.

$186 | WWW.ADOBE.COM/AU

Adobe has introduced new tools for organising photos in Lightroom 6, but the main additions are to the editing tools. There are also exciting new panorama and HDR tools, and it's now possible to "brush out" areas adjusted with the Graduated and Radial filter tools. Lightroom 6 introduces face recognition, and comes with new HTML5 web galleries and a major upgrade to the Slideshow tools.

Blending several images to make an HDR composite is simple. There are options for "deghosting," if you have objects moving between the frames. It can take a minute or so to blend the images, eventually producing a realistic image with the shadows and highlights intact. Panaroma merges follow a similar process and result in seamless compositions.

It's now possible to manually mask out areas modified by the Gradient and Radial Filters; it's also now possible to move the "pins" created by the Adjustment Brush.

It's a little odd to find face detection and recognition tools in a professional image application. At first, Lightroom can still identify unique faces and group them together, but you have to tell it who these people are. The more you use it, though, the more it's able to suggest names automatically.

There are many other small improvements too, and it all adds up to make Lightroom a great mid- to high-end photo app — and for Mac users, it's a solid alternative to Aperture. If you're a photo enthusiast, expert or professional, you need software which can organise, output and enhance your pictures; with a few minor quibbles, Lightroom is the best choice. **Rod Lawton**

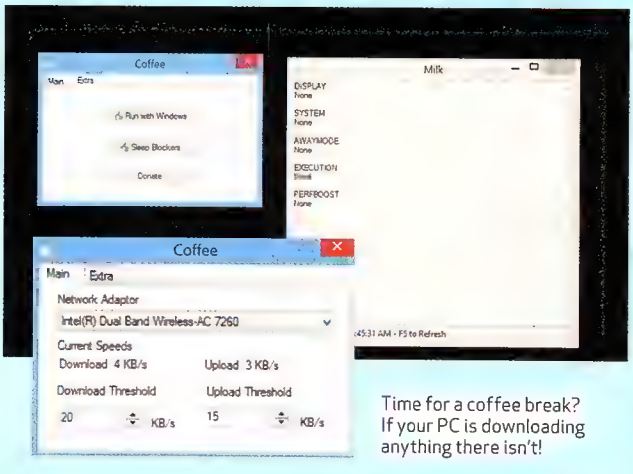
We find facial recognition a little strange in a professional image application, but it's here nonetheless.

Coffee

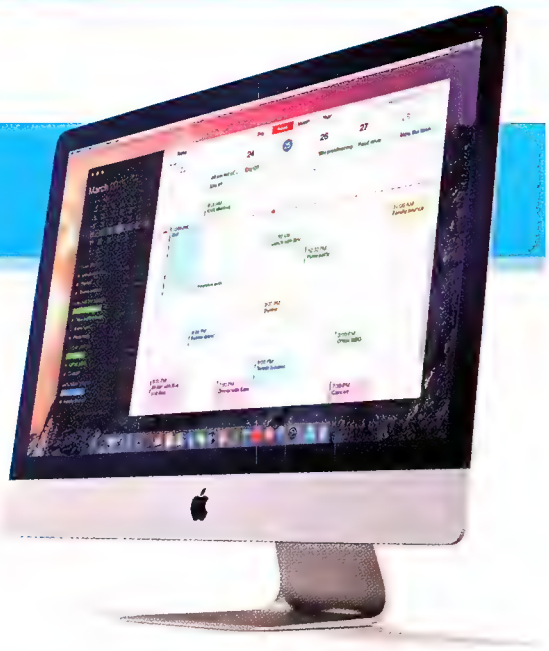
FREE | SOURCEFORGE.NET/PROJECTS/COFFEE-SC

Windows power saving features — telling your PC when to do things like turn off a monitor or go into standby mode — can be quite aggressive and while they've have gotten more nuanced with successive versions of Microsoft's OS, they're still far from perfect. Coffee is an open-source utility that aims to fix a fairly simple problem (and one that Windows power options sadly neglect) — it stops your PC from nodding off if there are active downloads or uploads. This means you can start a big download — a digitally-delivered game on Steam, for example, and not worry that it'll be stopped half-way through by your PC going to sleep.

There's not much to Coffee in terms of config: you can set upload and download thresholds in KB/s, make it automatically start with Windows, or use a built-in tool to view any apps or services that are blocking sleep. And that's about it. We've found setting both to about 10-15KB/s is the sweet spot — this ignores any idle web traffic that might be coming from your browser or other internet apps. You'll also want to make sure you quit and restart the app once you've applied your settings: we've sometimes found that changes don't get applied after a reboot if you don't do this. This may be a simple app, but if you need the features on offer, it comes highly recommended. **Dan Gardiner**



Time for a coffee break? If your PC is downloading anything there isn't!



Fantastical 2 for Mac

A powerful, flexible calendar app for those who need more.

$49.99 | FLEXIBITS.COM

For many of us, keeping up with work and play requires a different kind of calendar app than what Apple provides, and Fantastical 2 is Flexibits' response. While it has the look and feel of Apple's own Calendar, Fantastical brings polished power to organising your time.

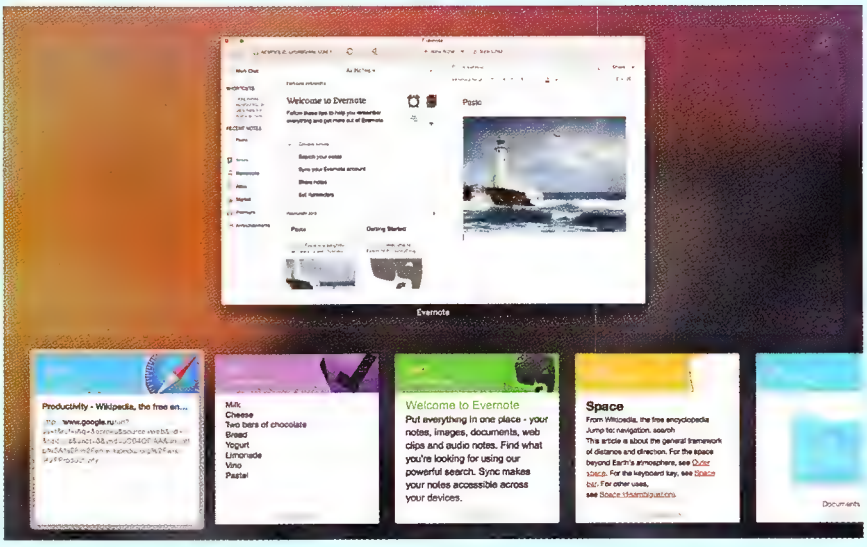
At first glance, Fantastical looks like a typical calendar app, with its day, week, month and year views for your schedule. But it quickly pulls ahead with features like a powerful, smart "natural language" engine that lets you type the names, locations, and times of your events as if you were just jotting them down, it recognises times and dates to add to the calendar. You can even specify calendars and a repeat interval all with a couple keystrokes.

One drawback, however, is that it takes some time to learn the syntax and commands to create new events and tasks. We feel it would be easy and helpful for Flexibits to add a cheat sheet somewhere, similar to the way in which tapping the question button in Siri shows the commands and different features it understands. Speaking of tasks, if you make use of Apple Reminders for to-do lists, Fantastical makes things even easier by grouping them with events in a scrolling day-to-day view in the sidebar. This is where the 'calendar sets' feature can be really useful – you can quickly switch between, say, a group of calendars and reminders for work, versus personal or volunteer events and tasks. We really like this agenda view, and wish Flexibits could hide the month view at the top to make more room. You can even argue that Fantastical is a better OS X Yosemite citizen than Apple's own Calendar: it supports a Share/Action Extension, a new Yosemite feature, which makes it easy for you to create events from any app that supports such extensions. One of the best parts of Fantastical is that, when it's time to get to work with one eye on your schedule, you can set aside the big calendar window and just use the useful menu bar companion on its own. With a click or keyboard shortcut, you can show a condensed, scrolling agenda view of your day's events and tasks right from the menu bar, and even add new items to your agenda using that convenient natural language recognition.

David Chartier

Paste

$12.99 | PASTEAPP.ME



The lack of a proper, built-in clipboard manager remains one of the more elusive shortcomings of Apple's OS. Thankfully, Paste largely eliminates this pain point. Once installed in the Finder menu bar, Paste remembers everything you copy, tucking it out of sight for later use. With a keyboard command (Shift-Command-V), these saved bits of data can be recalled and pasted into the current application with or without styling, or sent directly to other apps and devices via OS X's share extension. The clipboard history appears on a scrollable row across the bottom, colour-coded according to which application the item was copied from, and what type of data it contains. The magnifying glass icon (upper left) makes it easy to search text or application and file types by typing into a field.

Paste isn't yet as convenient or robust as our longtime favourite clipboard manager iClip, which can be configured to spring into action from any edge of the screen.

Paste also lacks a way to manually sort history items (although they can be deleted) or assign frequently used favourites, but is otherwise a useful addition to any power user's Mac utility belt. It manages your clipboard history in style, though not the most full-featured solution.

J.R. Bookwalter

NINE

Visualising your to-do list.

FREE | TINYURL.COM/M4Z7KYM

Everyone's seen their fair share of to-do list apps in the past, so you'd be forgiven for thinking that there's no way that they could ever be made interesting. Seriously, lists on a screen? Yawn! Boring! Thankfully, Ideas Made Digital has put some effort into creating a more visual style of to-do list app which is not only more fun to look at, it's also more fun to make lists with.

Simplicity is NINE's bread and butter – simply take a picture of something that will remind you of the task at hand (or import a picture from your camera roll), apply a label (preferably one that will make sense at a glance) and then select one of nine everyday actions to apply to it, such as Do, Go, Listen, Watch and so on. NINE will automatically record the location of where the note was created, which makes more sense when you're out and about than when you're in the bathroom. Truly a unique and fun to-do list alternative.

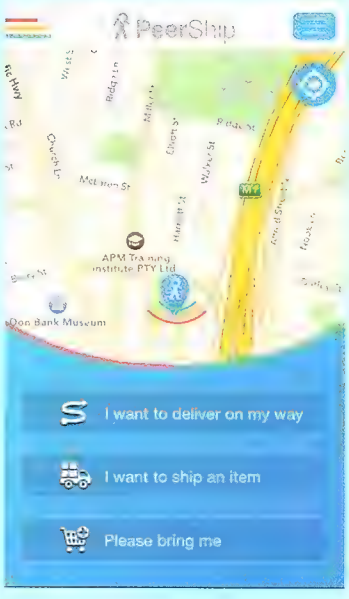
Stephen Lambrechts

PeerShip

FREE | TINYURL.COM/MZ6N8HG

With the success of Uber, the service that lets anyone with a car become a chauffeur, and Airbnb, the service that lets anyone with a spare room become a hotelier, it was only a matter of time until a similar service would arrive that would let people make deliveries like a courier. Introducing Peership, an app that lets people choose a price they're willing to pay in order to get something brought to them, or how much money they're willing to accept to bring them that something.

Simply describe the item you want, give your pickup and delivery information, and make an offer. If your offer isn't unreasonable, you'll likely find a match willing to drop it off for you. Or, you can opt to be the courier and use the app to make a little extra money. Just like Uber, delivery people have ratings on Peership, which will help you gauge whether or not they can be trusted to show up to your location.



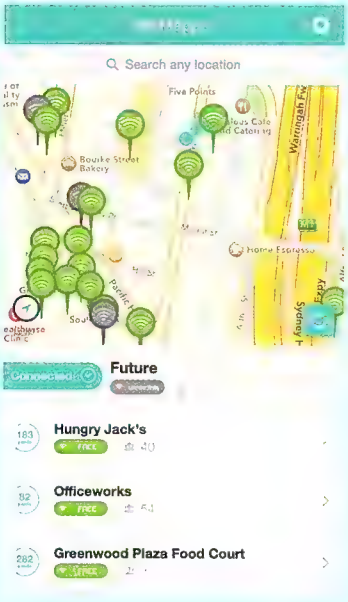
Stephen Lambrechts

WifiMapper

FREE | TINYURL.COM/MEEFEZT

Boasting the largest database of free Wi-Fi hotspots in the world (500 million and counting), WifiMapper's primary goal is to point you in the direction of accessible Wi-Fi, anywhere in the world. With WifiMapper in your back pocket, you're liable to cut down on your data roaming charges significantly.

WifiMapper gives you the option of browsing free Wi-Fi locations on a map or in the form of an easy to read list. Because the hotspots are community sourced, you can view detailed comments about each Wi-Fi spot, including ratings on whether they're great or worth bothering with at all. You can also get other important information about each hotspot at a glance, such as whether registration is required, if the network is secure, and you can also find out if the hotspot is limited by time. The app also pulls in comments from Foursquare, so you can get a read on the location before you attempt to head to it. Quite frankly, WifiMapper is invaluable.



Stephen Lambrechts

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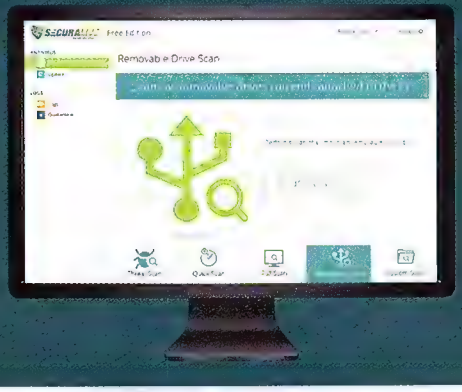

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Google Play » ANDROID

Clarity Keyboard Beta

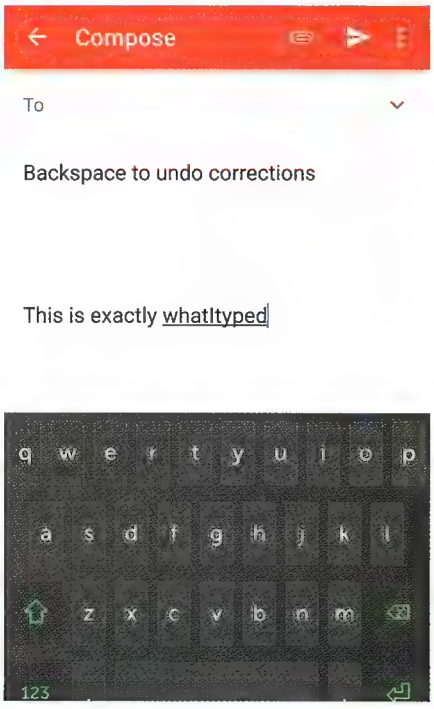
An experimental keyboard from the makers of SwiftKey.

FREE | TINYURL.COM/Q34PE8U

Entering the Google Play store as a beta, SwiftKey Greenhouse's experimental new keyboard app, Clarity Keyboard, offers users a keyboard alternative based around predicting your style of writing. Setting it up involves answering a question about the way you write – do you type slowly, making sure everything is grammatically correct, or do you fly through your messages and fix mistakes later? The way you answer should give you a Clarity keyboard tailored around your habits.

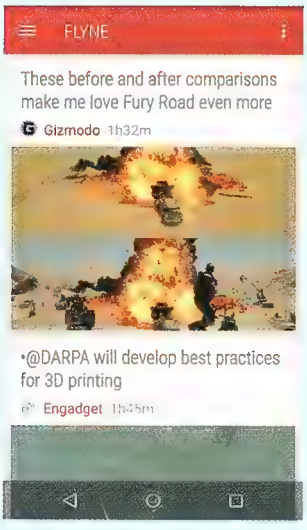
The idea is to let people type away without having to go back and correct words or add punctuation, as Clarity's 'multi-word autocorrect' should be able to automatically do that stuff for you. If the keyboard makes a mistake, hitting backspace into an auto word will automatically undo Clarity's suggestion.

And, like the SwiftKey keyboard before it, Clarity Keyboard will start to recognise the words you use most often, including phrases and slang words, so that your typing experience should become more streamlined over time. This beta version still needs work, but it's a good start. **Stephen Lambrechts**



Flyne

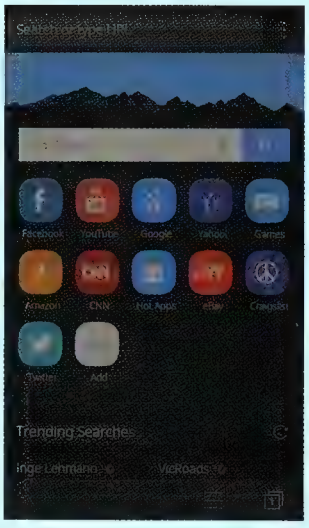
FREE WITH IAP | FLYNEAPP.COM



Considering how annoying RSS-reading app Feedly can be on Android — replacing the scrolling feature with pages of unrelated threads that are lumped together, followed by unpredictable whole screen features — we reckon it's worth having a look around for something that works a little better on the Google smartphone platform. Fortunately, the developer behind the highly-regarded Android Twitter client Falcon Pro has shifted his eagle eye to an Android app for RSS lovers. The free version of Flyne offers its own aggregated news stream, which can be customised based on topics you're interested in... and as far as free news feeds go, it isn't half bad. But the real crux of the app emerges through the in-app purchases: a Feedly connection (US$0.99) and a Twitter plug-in (US$1.99). The ability to aggregate these sources is pretty handy, especially if you're someone who likes to have a bunch of news waiting for you in the morning. The slick interface unfortunately doesn't include swipeable actions for marking things as read, but the overall design looks good and there are plenty of different ways to export stories. Plus, you can still read all the headlines even if you're offline. **Joel Burgess**

CM Browser

FREE | CMCM.COM/EN-US/CM-BROWSER/



Picking the right web browser for your Android, which often uses expensive mobile data rather than Wi-Fi, is critical. But, arguably, there isn't all that much incentive to go beyond Chrome, although a great number of third-party browsers do offer interesting enhancements or extras in how they get the job done. The best of them seem to focus on a particular niche. CM Browser is one such effort — it was built by Cheetah Mobile, the company behind Clean Master — one of the highest-rated cleaning, optimisation and security apps in the world, so it won't be all that surprising to learn that the CM Browser is excellent at privacy and security. Not only does it have the ability to switch a page to incognito without opening a new tab, there's also a comprehensive selection of data settings, a generous suite of security options and an easy-to-find pop-up blocker. With some of the best browser encryption available and a small total file size, CM promises that it's both secure and efficient — even outpacing Chrome at times. A nice design and intuitive layout adds up to make CM Browser a safe browsing bet. **Joel Burgess**

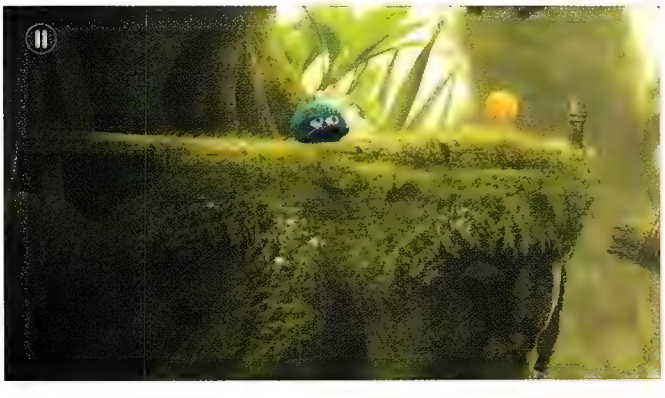
Leo's Fortune

A fuzzy ball's quest to reclaim a fortune.

US$4.99 | LEOSFORTUNE.COM

You can get a lot of mileage out of a well placed moustache, and there's no more archetypal specimen of this fact than the protagonist in *Leo's Fortune*. Playing as an aqua-coloured ball named Leo in a pseudo-19th century world, you've awoken to find your fortune of gold bullions has been appropriated and strewn through the moss-covered countryside and timber-reinforced mineshafts of this endearing platformer.

Equipped with the ability to inflate yourself to twice the size — which projects you up in the air, triggers levers, pulleys and buttons, and makes you fall at the speed of a balloon — Leo is capable of avoiding all the spikes, navigating the teetering tabletops and clearing the deadly voids that the game throws his way. But Leo hides even more abilities behind his pensive blue eyes and thick, well-groomed moustache and when the time calls he can even use his watery sack of a body to thrust down on a springboard and progress into new territory. A price tag of US$5 puts it in the more expensive category as far as app games go, but it's hard to argue it's not worth it when this fuzzy ball can float across the screen as majestically as a duck across a pond. Aesthetic intrigue and solid mechanics makes *Leo's Fortune* a Windows Phone gem. **Joel Burgess**



Pocket Casts

$4.29 | HTTP://TINYURL.COM/417CAST

Windows Phone users have had a stock podcasts app for some time, but anyone with the stamina to actually find channels using this podcatcher deserves some kind of diligence medal. Pocket Casts, on the other hand, has been streaming bite-sized audio shows since before iTunes even knew what a podcast was, and in that time its Aussie developers have managed to keep it on top of the long list of podcast managers that have popped up since. A discover section features curated lists of the trending, most popular and featured podcasts, making it easy to find new stuff. It'll also keep all your subscriptions in the one place and it can be set to automatically download new episodes when you're connected to Wi-Fi. That said, the Windows Phone version is slightly limited. You can't delete podcasts automatically once you've listened to them, for example, and some of the more specific settings, like the total library size cap, still seem a way off. At $4.29 it's not cheap, but if you regularly listen to podcasts this app — even the Windows Phone version — will make a difference. **Joel Burgess**

Readit

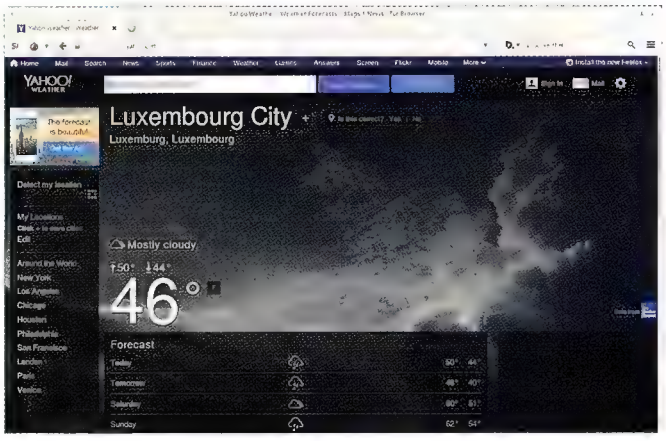
FREE | TINYURL.COM/APC417-READIT/

Readit, the popular Windows Phone client for Reddit, has just released an update — and it includes one of the longest lists of tweaks and bug fixes we've ever seen. Not only has this already slick-looking app received a massive overhaul, but the devs have decided that a price reduction from US$1.99 to free is also appropriate… and we'd have to agree. Topping the list of Readit 2.1 updates is the new ad-supported structure, which means the entire app is now free with none of the trial limitations imposed in the past. There've been changes to how GIFs are presented, and there's an added search ranking option that makes it significantly easier to find what you want. Not only has the interface changed dramatically, but the app also promises less crashes, more reliable subscribe functions and the extinction of an annoying random reset bug, to name a few. The full list of minor updates that can be found on the /r/readit Reddit subreddit (say that three times fast). For Reddit fans on Windows Phone, Readit is definitely worth downloading. **Joel Burgess**

Tor Browser

Stay private.

FREE | WWW.TORPROJECT.ORG



The Tor browser will probably be familiar to privacy-conscious Linux users. It's often mentioned as an essential component of various anonymising solutions. Tor isn't just a browser, it also includes a group of volunteer-operated servers that enable people to improve their privacy and security on the internet, and a user doesn't necessarily need to be tech-savvy, because everything is performed silently under the hood. This includes connecting through a series of virtual tunnels instead of making a direct connection, which means individuals can share information over public networks without compromising their privacy. Along similar lines, Tor is also an effective censorship circumvention tool as it allows users to reach otherwise blocked destinations or content.

Tor is based on a recent stable Firefox release with some important plug-ins and extensions that are set up and configured by default. These include: the HTTPS Everywhere extension for encrypting traffic on every site; NoScript for disabling JavaScript by default; and Fteproxy for resisting traffic inspection. Tor can even securely connect to web sites in restrictive environments, where, eg all traffic other than HTTP is blocked. Tor's security is achieved through obafs2/3/4 and ScrambleSuit transport layers that disguise Tor traffic and routes.

The new 4.5 version has some pleasing improvements, including a security level slider, a refined Onion menu and node chain isolation. It also blocks video properties in the browser API and has implemented methods to perplex user tracking and identification.

Tor Browser now uses the Disconnect search engine – based on the Google one – and doesn't collect any user data. The browser is distributed in the same way as a regular Mozilla product, and you're offered a vast list of builds for any combination of OS, language and 32-/64-bit package. So you download and extract the appropriate version and launch the Tor shortcut in the Applications directory. A simple wizard will help you to set a few settings and establish a connection through a chain of Tor nodes.

Alexander Tolstoy

Plank

FREE | LAUNCHPAD.NET/PLANK

Apple's OS X impressed many people with its beautiful and smooth dock and it's spawned numerous dock clones for Linux. The Mac OS's most thrilling visual effect was icon zoom, which was hard to implement while ensuring that the dock used a low amount of resources.

One of Linux's most appealing and handy docks is Docky, which is actually based on the simpler one called Plank. The goal of Plank is to provide just what a dock needs and nothing more, but it's a library which can be extended to create other dock programs with more advanced features. Thus, Plank is the underlying technology on which Docky is based (starting in version 3.0.0) and aims to provide all the core features while Docky extends it to add fancier things, such as docklets, painters, settings dialogs etc.

Nearly all the code is written in Vala and Plank settings are available in the right-click menu of the obligatory 'anchor' icon for most Linux distros (or in the system-wide Settings panel if you're using elementary OS). Despite being very simple, Plank has a decent amount of customisation, including icon size, hiding options, theme selector (new themes go in ~/.config/plank/theme), screen positioning and aligning, display placement (if more than one display is used). The only noticeable thing it's missing is animation options; the Plank dock doesn't provide them by design, as it aspires to stay simple. However, along with some new features and bug fixes, Plank 0.9.0 does add animation for adding and removing items, a new window dodge hide mode (the dock will hide if it obstructs any window), new option for setting a hide delay, fixes for recent GTK3 releases (>= 3.14) and more. Plank ships with elementary OS by default, but it's also available in a standalone PPA (ppa:docky-core/stable) for Ubuntu and its derivatives, and also in standard repositories of many other Linux distros (Arch, Fedora and CentOS to name a few).

Alexander Tolstoy

BUILD A 4K-READY MEDIA CENTRE

WATCH, STREAM & RE-ENCODE YOUR FLICKS & TV FOR ANY SCREEN — BIG OR SMALL!

Let's cut to the chase. While 4K — aka 3,840 x 2,160-pixels — may be the hottest new trend in both video and computing, it's not exactly the firmest of standards. Finding content as well as the necessary gear to play it back is still a bit of a wobbly area — there's no Blu-ray for 4K yet, for example (though it is coming), so much of the 4K content on offer must be streamed. This month, we've focused on building a PC-based media centre that can tackle your 4K needs — both now, and as the 'format' (well, as much as '1080p' is a format) matures.

Of course, not all your movies and TV are going to be in 4K, so we've also dug into some more general media-centre PC areas — such as how to stream and re-encode your video files to serve on portable (and other) devices, essential media PC apps, NAS boxes for media storage and much more!

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NEED A CENTRALISED SPOT TO STORE YOUR MOVIES, TV AND MUSIC? LINDSAY HANDMER TESTS FOUR AND FIVE-BAY NAS BOXES, WITH A PARTICULAR EYE FOR THEIR MEDIA FEATURES.

This simulated image from Dolby shows the difference that Dolby Vision (a form of HDR Video) should make to TVs.

A 4K video primer

What services support it, what's coming up, what do you need to play it back? Simon Chester & Dan Gardiner

4K. Four Kay. Ultra High Definition. UHD. Forky. Puuuurdy. No matter what you call it, the replacement for 1080p HD resolution is now a standard part of the home entertainment lexicon. Like the megapixel race of the cameras of yore, and the MHz race of CPUs of even more yore, there's been a push for higher resolution screens. And indeed, with larger TVs becoming standard, and projectors moving from 'enthusiast' to 'consumer' levels, there's a definite need for more pixels.

So, how many pixels are there in 4K, compared to 1080p HD? To start, the term '4K' isn't quite as clear cut as it should be: in the cinema world, 4K has been around for years, and has meant anywhere between 4,096 x 1,744 and 4,096 x 3,072 pixels (used across about 10 standard aspect ratios and sizes), whereas the consumer tech now referred to as '4K' or 'UHD' is generally 3,840 x 2,160 pixels. Why the difference? Well, 3,840 x 2,160 simply doubles the horizontal and vertical resolutions of the existing 1080p standard, resulting in four times more total pixels and allowing it to retain the 16:9 widescreen aspect ratio that digital TV is broadcast in and that all our TV sets conform to. In other words, it makes sense to stick with it.

While more is usually regarded as better, does it make sense to increase the number of on-screen pixels? As we've previously alluded to, on many screens and from most seating positions, your eyes aren't actually able to tell the difference between regular ol' 1080p HD and 4K. Where 4K does shine, however, is on the new, larger HDR screens.

[illegible]

How large, you ask? Well, in order for you to discern the edges of those 8.2 million or so pixels, you'll have to be sitting within 1.5m of a screen about 60-inch in size (the larger the screen, the further back you'll be able to notice pixels). On screens smaller than 55-inch, there's almost no point, unless you're sitting within a metre – like at a desk. For these reasons (and because 55-inch TVs make up 64% of all TV sales, according to LG), it seems unlikely that 4K TVs smaller than 55-inch will arrive on the market in the near future – even though 4K PC monitors are selling like pulled pork brioche burgers at hipster bars.

However, even if you don't buy into the arguments put forth for extra pixels, 4K videos – depending on their source – will bring a host of improvements in addition to their increased resolution.

First, though, let's discuss those sources, as getting your digital mittens on 4K video is actually a bit trickier than you might expect.

[illegible]

Perhaps surprisingly, despite there being a multitude of 4K TVs on the market, there is but a handful of external 4K playback sources and only a sliver of 4K content. Netflix and YouTube are the two biggest 4K streaming services at the moment, and while many 4K TVs out there will support Netflix natively via a wired Ethernet connection, there is only a limited number of 'UHD' (Netflix's preferred term) movies and TV shows available from the service. At the moment, there's no way to get 4K Netflix streams playing on your PC – the browser UI just doesn't support it. Hopefully this is something that Netflix will amend in future. Conversely, while there are a lot of people uploading 4K (cat) videos to YouTube, it's still only possible to access these from a PC.

Additionally, you'll need a hefty internet connection and download quota to be able to really take advantage of streaming 4K.

Netflix's 'UHD' stream clocks in at 15.5 megabits per second (Mbps) or 1.9375 megabytes per second (aka MB/s – note the capital 'B'). With the average connection speed in Australia at around 7.4Mbps (according to Akamai's Q4 2014 State of the Internet report) and only 16% of households on a connection above 10Mbps.

Netflix actually recommends an internet connection of greater than

Netflix is still the easiest and cheapest way to get 4K movies and TV shows into your loungeroom — if only through certified TVs at the moment.

25Mbps (3.125MB/s) for UHD, which eliminates ADSL2+ completely [insert political comment about the near-sightedness of the current incarnation of the NBN], which tops out at a maximum (and almost never achieved) 24Mbps or around 3MB/s. As such, if you're considering streaming 4K, we'd recommend popping over to **speedtest.net** and seeing how your connection rates, as if you're dead set on the idea you may need to switch to a more expensive cable or fibre link (if available, of course). Just be sure that you have a generous download limit, too, as you'll find a two-hour UHD movie from Netflix sits close to 18GB in size, and a 13-episode TV series at a staggering 117GB.

Notably, at the time of writing, no other Australian streaming services, such as Stan or Presto, support 4K. There are several services in the US that do, though, including Amazon, so if you have an unlimited quota VPN, that's definitely worth looking into (and, incidentally, by connecting to the US version of Netflix, you'll also get access to more 4K content than is offered on the Australian Netflix).

Crucially, if you're looking to stream Netflix to your 4K TV, check that it is indeed certified for it. It not only has to support the new HEVC codec, but Netflix itself has to certify devices for playback, too. (Some 4K TVs may only need a firmware upgrade to get that certification, thankfully.)

If your TV isn't out-of-the-box Netflix UHD compatible, you can consider hooking up a HTPC (home theatre PC) to your TV, and setting up a proper geek's lounge room. See our PC builder's feature on page 52 for full details, but at the minimum — that offers DisplayPort output, and preferably HDMI 2.0, as otherwise you may be limited to a 30Hz refresh rate. When it comes to 4K, the main benefit of an HTPC is that you can watch other 4K content, such as YouTube or anything you download yourself.

Playback of 4K content via USB storage is now a standard feature for 4K TVs, but wasn't the case in 2013 when the first models came out. Some of the cheaper 4K TVs may also have problems playing-back downloaded 4K content over USB, so make sure to check before you commit.

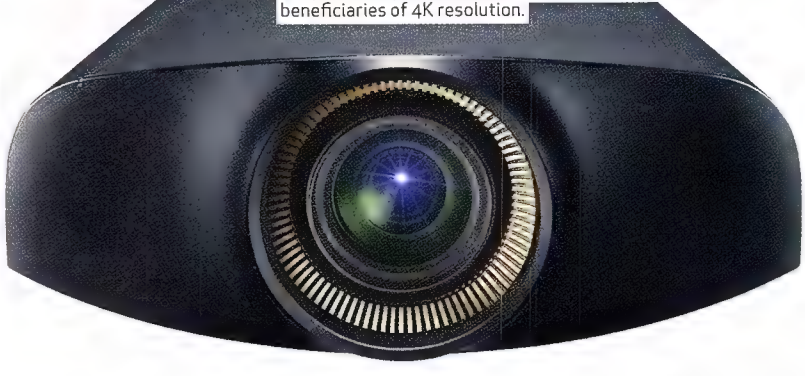
Another option for viewing 4K content on your TV is to purchase one of the many Android-based, 4K-compatible mini PCs now on the market (such as the Minix Neo X8-H Plus, which is just over $200 on eBay). While these can play back 4K movies, they're not certified for Netflix at anything above 1080p. (We haven't had the luxury of trying one out, so can't speak of their quality. Minix have been around for a few years, though, and seem to have a strong following.)

Unfortunately, games-console owners are basically out of luck when it comes to 4K: the Xbox One doesn't support it at all, and the PlayStation 4 only supports it at 30fps (thanks to its HDMI 1.4 port), and even then, the PS4's Netflix app only supports up to HD resolution, and the PS4 doesn't allow you to bring your own 4K videos and the PlayStation Video service only supports 1080p streaming.

However, rumours abound that both the Xbox One and the PlayStation 4 will receive hardware updates this year that will upgrade them to HDMI 2.0 and enable 4K playback at 60fps from streaming sources like Netflix,

The Minix Neo X8-H Plus is a cheap Android-based media PC that supports playback of 4K video – just not yet via Netflix.

Given their ability to produce massive screen sizes, projectors, like this $26,000 Sony VPL-VW1000ES, which can produce up to 300-inch of 4K goodness, are the biggest beneficiaries of 4K resolution.



The differing resolutions for 8K UHD, 4K UHD, Full HD and SD.

Will I see a difference?

A handy calculator for 4K 'visibility' is available at **referencehometheater.com/2013/commentary/4k-calculator**. Just punch in the distance you sit from your screen, how big your current (or desired) screen is, and how good your eyesight is, and it'll tell you what size screen you'll a) need to be able to tell the difference from HD, and b) how big it can be before you'll see pixels. I sit about 4 metres from my screen (that's 13 feet for the calculator), and it reckons that I shouldn't bother going 4K unless I get a screen between 90- and 180-inch. I'm sure my partner will understand; it's SCIENCE!

Netflix requirements for 4K

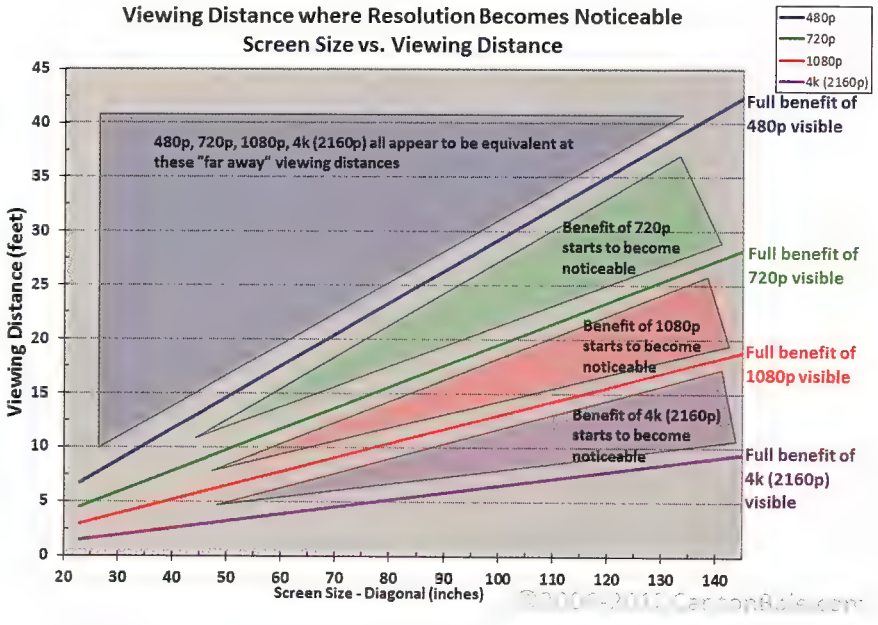
Not all 4K TVs' Netflix apps support 4K streaming — Netflix needs to certify them before you can access its UHD content. You can find a list of certified Netflix devices at **devices.netflix.com** or **en.wikipedia.org/wiki/List_of_Netflix_compatible_devices**. You can also learn a bit more about Netflix's UHD requirements, in terms of internet connection and device compatibility, at **help.netflix.com/en/node/13444**.

and maybe even locally-stored content, too. They may even support the soon-to-be-released 4K Ultra HD Blu-ray discs.

4K BLU-RAY – MORE THAN JUST PIXELS

4K Blu-ray discs should be coming out before the end of 2015 (there were some prototype 4K Blu-ray players seen at CES earlier this year, so they're getting closer). The discs will be encoded using the newer HEVC/H.265 codec, which is a much more efficient method of compression (in fact, HEVC stands for High Efficiency Video Coding).

In tandem with this improved compression will be an increase in the capacity of Blu-ray discs – up from 25GB or 50GB to 66GB and even 100GB. Most notably – and this is where the superiority of physical media over streaming plays out – all that extra space will allow for more than just extra pixels: each pixel will also be filled with more data! So, movies coming on the new discs will also support a wider colour gamut, better contrast, and faster frame rates.



Carlton Bale (**s3.carltonbale.com/resolution_chart.html**) has created a handy chart where you can see the limits and benefits of 4K, 1080p, and 720p resolution when viewed on a given screen size from a given distance.

Movies stored on 4K Blu-ray will use what is called the BT.2020 (aka Rec. 2020 or ITU-R Recommendation BT.2020) standard for video, which defines a video format's resolution (either '4K' 3,840 x 2,160 or '8K' 7,680 x 4,320 – although it will be a while before we see anything 8K), its possible frame rates (from 24 up to 120 – useful for 3D – with many stops in-between), and the bit-depth of the data (either 10 or 12 bits per sample – up from the 8 bits seen today, which translates to a jump from 16.78 million colours to 1,073,741,824 colours for 10-bit and a whopping, staggering, jaw-dropping 68,719,476,736 colours for 12-bit).

Now, the BT.2020 recommendation is built for the future, so 4K Blu-ray will sit at the bottom of the specs – that is 4K resolution, 24fps (for most content, but up to 60fps for some), and 10 bits per sample – but this is still a fundamental shift in picture quality. So much so that current TVs can't even display all those new colours and shades (and that includes many current 4K sets), and will likely have to sample-down when faced with them. That is, unless you have an 'HDR' TV.

THE FUTURE IS HDR VIDEO

'HDR video' (or High Dynamic Range) has been an industry buzzword for a bit, but really made itself known at this year's CES, where there were sample TVs on display from LG, Sony, Samsung, Philips, Panasonic and others, and Dolby announced its standard for HDR, known as 'Dolby Vision'.

The 'dynamic range' that HDR refers to is basically the difference between the darkest object and the brightest object that can exist in a frame together – in this sense it's almost another term for 'contrast ratio.' However, it also encompasses the possible shades of colours, too. And, as contrast ratio plays a bigger part in the perceived quality of an image than resolution, you can see why we're a little excited about HDR screens and HDR movies (whether via a lightly compressed 4K Blu-ray or heavily compressed Netflix stream) coming to our home theatres.

Basically, with an HDR movie playing on an HDR screen, expect significantly more realistic pictures – not only will you have deeper blacks alongside brighter whites, you'll also have many, many more shades and colours in between. It's actually quite a technical achievement to have so many colours and shades displayed on a panel, and has only become possible recently thanks to 'quantum dot' coloured backlighting technology for LCDs as well as the maturation of OLED panels.

Sadly, however, as at the time of writing, there's been no mention of a firm release date for 4K Blu-ray (or whatever it may ultimately be called), but rumours are pegging it as 'late 2015.' Like every other launch of a new medium, expect both the players and the releases to be very thin on the ground at launch. However, unlike when Blu-Ray launched back in 2006, there isn't a competing physical format, like HD DVD or Betamax (just video on-demand streaming services) – all studios are on-board to support it as the medium of choice for 4K content, which is a boon for consumers.

The biggest challenge for 4K Blu-ray, however, is the very simple fact that sales of physical media are down. And as shiny and technically impressive as the format is, Joe Consumer won't care a hoot about it if he can get the 'same thing' streaming over Netflix. So, watch this space for updates. ■

Samsung's 2015 flagship TV, the 65-inch UN65JS9500, offers 'HDR' video via quantum dot technology.

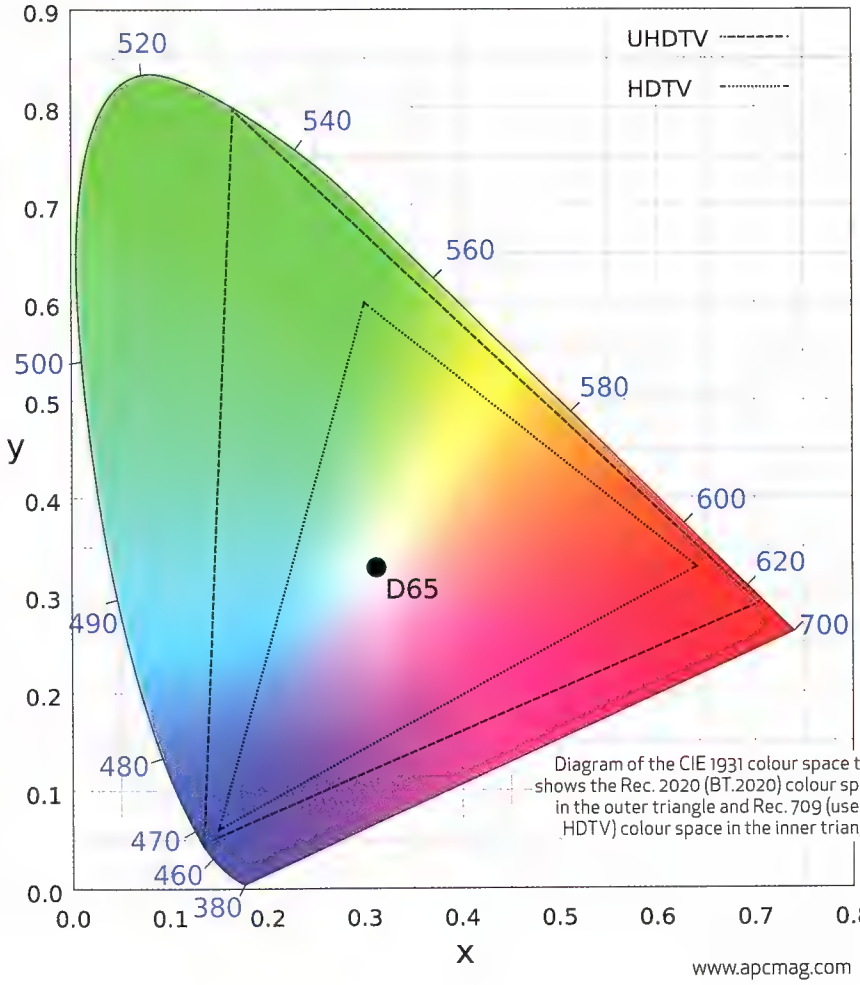


Diagram of the CIE 1931 colour space that shows the Rec. 2020 (BT.2020) colour space in the outer triangle and Rec. 709 (used in HDTV) colour space in the inner triangle.

4K LOUNGE ROOM PC

A quiet PC-build that games and movies at 4K resolution? Darren Yates looks at how to put together the Holy Grail of computing.

It'll be years before we see 4K-resolution transmissions from Australia's TV networks, but with PC gaming, Netflix and even new smartphones capable of generating 3,840 x 2,160-pixel content (and 4K Blu-ray reportedly arriving by the end of 2015, tinyurl.com/qy9v7q2), it's worth looking at how to make your next PC build 4K-ready.

Yes, Microsoft has killed off Windows Media Center (**tinyurl.com/lc9o5e9**), but with alternatives like Kodi (formerly XBMC), your loungeroom is still in good hands. However, a loungeroom PC that's ready for 4K still needs a futuristic mix of performance and peripheral connections, ideally in a package that won't have your neighbours complaining about the noise or their lights dimming.

It starts with sorting out your 4K expectations – if they stop at movies, a quiet system build needn't be complicated, but if you're expecting serious gaming at that resolution, keeping things quiet and compact becomes a little more problematic.

MOVIES FIRST

The smart way to build a quiet loungeroom PC is to use it for content display, not content storage – keep your movie library on a server elsewhere and stream. It cuts down the size and cooling you'll need for your family-room system. We'll talk more about components shortly, but the key consideration is your video signal connection – and that's a bit of a minefield.

We've had HDMI (High-Definition Multimedia Interface) in its current 'version 1.4' strain for several years, thanks to the starburst that was '3DTV'. But HDMI 1.4 has only what we'd call 'rudimentary' 4K TV support – it delivers the standard 3,840 x 2,160-pixels, but only at a maximum 30Hz refresh rate. It's adequate for movies, but definitely not good enough for general PC monitoring and gaming.

CHROMA YOUR LUMINANCE

For best results, you want your 4K video refreshed at 60Hz minimum, just like your PC monitor. But for that, you typically need the bandwidth-imbibed DisplayPort 1.2 or HDMI 2.0 bus options.

However, that's only part of the picture (pardon the pun). Video images are sampled into pixels, but they're also encoded by their luminance (light) and chrominance (colour) components. The most spectacular-quality 4K video uses full-resolution zero-compression colour, often quoted as '4:4:4', where the first number is the luminance (Y), the second is the blue-difference chroma (Cb) and the third, red-difference chroma (Cr). Combine these and you get the colour space for digital video known as YCbCr.

HDMI 1.4 can only deliver this gold-star 4:4:4 YCbCr colour resolution of 4K video at 30Hz – the bandwidth needed for this colour at 60Hz is one reason why we have the new HDMI 2.0 spec. Before HDMI 2.0, only DisplayPort 1.2 could deliver this.

This isn't meant to be an in-depth on 4KTV, but be aware – not even HDMI 2.0 guarantees you 4:4:4 YCbCr colour. Sony's 49-inch KD-49X8500B 4K TV, for example, claims HDMI 2.0 and 4K at 60Hz, but read the specs and its 4K@60Hz output isn't 4:4:4 YCbCr (check under 'specifications at **tinyurl.com/kjjz2wg**). Instead, it uses 'chroma subsampling', a compression technique that reduces the colour resolution by half in both horizontal and vertical planes, written as '4:2:0 YCbCr'. Chroma subsampling reduces the data bandwidth required and it's the main difference between many 4K TVs and 4K monitors – all 4K monitors should be capable of 4:4:4 colour at 60Hz, but many 4K TVs available at the moment only support 4:2:0 colour at 60Hz. The reduced colour resolution will be less noticeable on movies, but try and use a 4K@60Hz/4:2:0-

colour TV as a PC monitor, particularly on text, and the colour problems become apparent.

GAMING AT 4K

If FPS gameplay is more your thing, you also have the added issue of needing sufficient graphics horsepower because you're not just displaying or even decoding 4K-pixel frames now – you're generating them and that requires considerably more muscle. In fact, based on the game frame rates we've seen, you'll need at least a GeForce GTX 980 or a Radeon R9 290X to get anything like 'playable' rates at 4K, and even then, you're looking at only between 35 and 50fps on something like *Crysis 3*, depending on quality settings. These cards typically have multiple fans as well, so 'silent' becomes a relative term. Talk multi-GPU gaming and the issues are multiplied.

STREAM YOUR GAMES?

A 'quiet' alternative you might think of is 'game streaming', a bit like streaming your movies from a NAS box, but instead, you stream your games' audio and video from your gaming rig to your loungeroom PC. Steam's In-Home Streaming has been around for a year or so now and it has been seen to work at 4K (**tinyurl.com/p43lk6t**). However, the game must be running on your gaming rig at 4K resolution to get 4K output from your loungeroom PC. That implies a 4K monitor on your gaming rig.

And it doesn't end there. Since you're sending control data in one direction and AV data in the other, you also need top-flight networking performance, especially in terms of latency, if you want the gaming experience to feel 'connected'. Otherwise, the delay between you activating a control and seeing the response could drive you absolutely barmy.

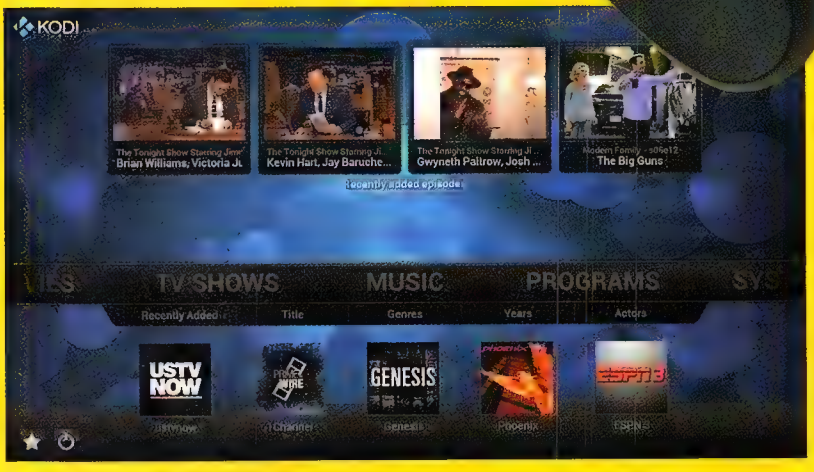
QUAD-CORE CPU THE GO

Generally, it is possible to playback 4K video at 30Hz on a late-model dual-core Core i3 Intel CPU, depending on the video compression used. Intel has provided hardware accelerated decoding for HEVC (H.265) and Google VP9 video (accelerated H.264 is already included) on Haswell (4000-series) and Broadwell (5000-series) Intel chips since driver release 15.36.14.64.4080 (**tinyurl.com/lqpphcx**). However, to get 4K@60Hz output, you need at least Intel Iris Pro 5200 graphics from Haswell R-class CPUs. Intel's HD 5500/6000/6100-class graphics inside up-coming desktop Broadwell CPUs should deliver 4K@60Hz, but weren't available at time of writing. Even so, we'd recommend a quad-core Core i5 to ensure a reasonable amount of performance headroom.

ESSENTIAL PERIPHERALS

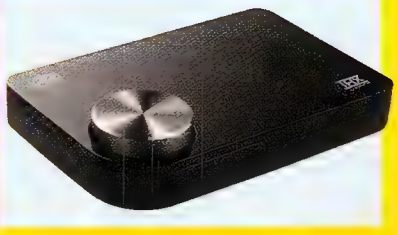
IR/WIRELESS REMOTE CONTROL

A good wireless remote is essential for loungeroom use. Hauppauge still has IR remotes for Windows Media Center, but increasingly your Android smartphone or tablet will work with apps such as Kodi (formerly XBMC).



WIRELESS KEYBOARD WITH TRACKPAD

Wireless USB keyboards like Logitech's K400r are a reasonable choice for compact data entry and go for under $40 on special. The K830 with its backlit keys is even better suited to low-lit loungerooms.



USB AUDIO

ASUS' Z97I-PLUS should be one of the better audio performers, but we recommended external USB audio to give gaming and movie sound tracks the platform they deserve. Creative's X-Fi Surround 5.1 Pro at around $90 is a good place to start.

DARREN YATES OUTLINES THE MAJOR COMPONENTS HE RECOMMENDS FOR HIS 4K LOUNGEROOM PC BUILDS.

CASE

SILVERSTONE MILO ML06 ($70, VIDEO ONLY), CORSAIR OBSIDIAN 250D ($130, GAMING)

Alternative: BitFenix Prodigy ($99, gaming)

Being a loungeroom PC, this thing needs to look good, so we've gone for SilverStone's ML06 and Corsair's Obsidian 250D for cases. The ML06 is the size of an old VHS recorder, so, a warning — it'll be a tight fit and you'll need an SFX PSU. But, you will have a build that won't look out of place with any Hi-Fi system.

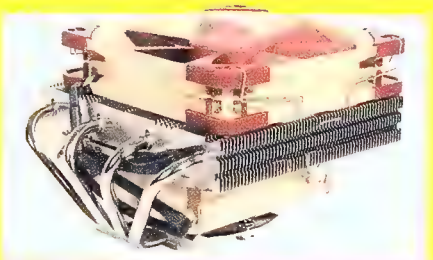
The Corsair Obsidian 250D costs $30 more than BitFenix's Prodigy, but better fits most loungerooms. A more open design than the Prodigy, the 250D is solidly built and dust-proof, thanks to its magnetic dust covers. It'll also take a stock GTX 980 graphics card (beware those with custom coolers).

ASUS Z97I-PLUS ($190), ASUS H97I-PLUS ($135)

ASUS boards are always well-presented, if not necessarily leading the way on value. The Z97I-PLUS includes dual-band AC Wi-Fi, ideal for loungeroom streaming. The H97I-PLUS is almost identical, but with the H97 chipset and loses wireless to save around $55.

INTEL CORE I5 4590S (FOR ML06, $300), INTEL CORE I5 4590 (OTHERWISE, $270)

The 4590S is part of Intel's 65-watt thermal design power (TDP) rating S-series. You could possibly save $30 with a standard 84-watt Core i5 4590 and underclock it (provided the motherboard supports it) to get within the NHL9i's cooling range. In either the 250D or Prodigy cases, the Core i5 4590 will be fine.



NOCTUA NHL9I ($65, ML06 CASE), NOCTUA NH-L12 ($90)

The ML06 case leaves little room for CPU cooling, but the NHL9i, at just 37-millimetres tall, should combine well with the Core i5 4590S. The Obsidian 250D case only has 95-millimetres clearance above the motherboard, but the single-fan NH-L12 is exceptionally quiet and just 66-millimetres.

SANDISK ULTRA II 240GB SSD ($150)

Sandisk's Ultra II is among the only non-Samsung TLC (triple-level cell) SSDs and is even cheaper per GB than Samsung. If you're not into gaming, stream your movies from a NAS server and go the 120GB version instead. For gaming, 240GB should handle half-a-dozen big-budget FPS games before you need to worry about space.

EVGA GEFORCE GTX 980 SUPERCLOCKED ACX 2.0 ($830)

The 250D case only supports 290-millimetres of GPU card length and has limited clearance above the card. We'd go EVGA's Superclocked ACX 2.0, which is a stock 267-millimetres long and its low-profile cooler also fits the vertical dimensions of the case. Many GTX 980 cards are longer and taller, so choose carefully. The PCI-E power connectors may still be a tight fit. GTX 970 cards are a cheaper alternative but offer lower 4K performance.

SEASONIC X-650 ($200, 650-WATT FOR GAMING), SEASONIC G-450 ($110, MOVIE), SILVERSTONE SFX 80+ GOLD 450W ($120, ML06 CASE)

The GTX 980 requires a minimum 500-watt PSU and the quietest one we'd use in a 250D-style case (with the motherboard directly above the PSU) is Seasonic's X-650. It's not cheap at around $200, but as quiet as they come and Seasonic PSUs are virtually bulletproof. If you don't game, Seasonic's G-450 uses a slightly noisier fan but at only half the cost. SilverStone's ST45SF-G (SFX 80+ Gold) is the paired (and quietest) option for the ML06 case.

THE BUILD

PUTTING TOGETHER YOUR 4K PC IS ALL ABOUT COMPONENT CHOICE — AND KNOWING WHAT FITS. **DARREN YATES** EXPLAINS.

To be blunt, it's pretty difficult to stuff up a standard tower PC build these days — you'd have to be either exceptionally unlucky with your component choices, or trying to fit a whole computer store's worth of components inside.

But building a Mini-ITX system, there's no room for luck — you have to know all components will fit right from the get-go. And that means it all begins with the case. It presets your physical dimensions — the three key dimensions being the height above the CPU, the space around the PSU, the length and height for a graphics card.

GETTING CLEARANCE

Whether you use the tiny SilverStone ML06 case or the comparatively roomy Corsair Obsidian 250D, you need to know the spaces around these three key components. For example, the ML06 is only 99-millimetres tall — add the motherboard, the CPU and SilverStone says you've got 70-millimetres maximum for the CPU cooler, still a pretty tight squeeze. Intel's stock low-profile cooler should fit, but stock doesn't mean the quietest option either.

Motherboard compatibility listings from third-party cooler makers make for good reading: Noctua's NHL9i is only 37-millimetres tall and known for its quietness, but comes at a cost — it's not recommended for 84-watt TDP CPUs. Reduced cooling capacity means it runs CPUs hotter than other coolers. As for the 250D, you only have 95-millimetres (says Corsair, **tinyurl.com/l35r7yq**) of empty air. Further, the 250D's Perspex top panel requires some clearance to ensure you don't overcook it.

The same clearance issues apply for PSUs — as we've said, the ML06 needs a special SFX form-factor PSU. Even larger ITX cases have a maximum PSU length they'll support. The BitFenix Prodigy case, for example, limits length to 160-millimetres, as the case encloses the PSU. By contrast, the 250D leaves this space open, allowing up to 180-millimetre long PSUs.

SilverStone's 450-watt ST-45SF-G is the best SFX PSU for an ML06 case.

> "The ML06 is only 99-millimetres tall – add the motherboard, the CPU and SilverStone says you've got 70-millimetres maximum for the CPU cooler, still a pretty tight squeeze."

GRAPHICS CARD FIT

Adding a PCI-E graphics card requires sufficient length to handle larger cards like the GTX 980. But there are added issues as well — the 250D has limited clearance above the card, so you need to beware of custom coolers. ASUS' DirectCU II cards, with their custom high-profile coolers, are said to foul the 250D's top cover. Choose stock-design/minimum-height card coolers that are as close as possible to the height of the standard rear-retaining bracket. Make sure you check the PCI-E power cables also fit in the available space beneath the case lid — it will be tight.

HOW EASY IS IT TO BUILD?

The one thing dimensions don't fully tell you is the difficulty in putting mini-ITX systems together. Our hot tip is don't try to fit components into spaces down to the last millimetre. Not only does this restrict airflow, but we've found you can't always take quoted specs as gospel. Motherboard stand-off sizes, for example, can change the above-CPU clearance. You also need to consider room for routing cables, particularly with GPU PCI-E power cables. The smaller the case, the more conservative your choices need to be.

If nothing else, you can see how vital research is in creating any mini-ITX build. Choosing components on price and performance is an age-old axiom, but when you start talking 'mini-ITX', considerations literally do take on a whole new dimension. ■

A GeForce GTX 980 card delivers 4K gaming speed, but watch the dimensions.

Gigabyte's low-end BRIX mini PCs share much in common with Intel NUCs.

4K on a budget

Spent your inheritance on the TV and nothing left in the loungeroom PC kitty? Darren Yates looks at how to scrounge a build that's 4K-ready.

Building a 4K-ready lounge room PC on a budget means getting right back to the basic question: how much 4K gaming are you expecting? Your answer determines whether 'budget' and '4K' can co-exist.

Provided you can stand the noise of the old PSU fan, you could press your old left-over PC into service – and there's even a chance it'll work. Video playback of 4K content at 30fps might work on as little as a late-model Core i3 box – even on integrated GPUs, provided you use a video codec with iGPU-hardware accelerated support. However, the more pressing problem will be a lack of 4K video transmission support – the old HDMI v1.4 standard on most PCs and notebooks will support 4K but only to a 30Hz refresh rate. That may be enough for movie playback on a 4K TV, but no 4K monitor will look worth its money with less than a 60Hz signal and to get that, you'll need an HDMI 2.0 port or DisplayPort 1.2 connection, along with multi- (MST) or single-stream transport (SST) GPU drivers to suit your gear.

[redacted]

But Nvidia quietly released a band-aid solution in June 2014 for those using older Kepler GK-class GPUs (generally down to and including the GeForce GTX 650). Beta R340 drivers enabled these GPUs to pump out 4K video at 60Hz refresh rate over HDMI v1.4 using the 'chroma subsampling' technique to drop the colour space down to 4:2:0 YCbCr. The pixel resolution remains the same, but the colour accuracy drops, along with the overall signal bandwidth, back to within HDMI v1.4 territory.

If you already have at least a GeForce GTX 650 GPU, you just need the latest driver (352.86 WHQL at time of writing). Now, we can't guarantee every 4K TV will recognise this signal, since it's a workaround and outside normal spec. Your TV must support YCbCr 4:2:0 over HDMI, it reportedly doesn't work with multi-card SLI and even if it does work, the colour compression won't look as good as genuine 4:4:4 YCbCr 4K video. But if you already have all of the components, you only need to download the WHQL Nvidia GPU driver to try out.

The 450-watt G-450 PSU from Seasonic is a good value compromise

EVGA's GTX 960 ACX 2.0 card can't 4K-game, but has HEVC decoding.

BUDGET BUILD FROM SCRATCH

If you're building from scratch, however, the cheapest option for now is likely to be Intel's NUC (Next Unit of Computing) barebones mini PCs, provided you choose one of the latest fifth-generation Broadwell models. Only Broadwell NUCs support 4K video at 60Hz refresh-rate – and even then, only via DisplayPort. The HDMI port is still only version 1.4 and limited to 30Hz refresh rate. Choose anything older than Broadwell and you'll be stuck at 30Hz, regardless.

At the moment, there are three Broadwell options available – all dual-core, based on Core i3/i5/i7 U-class CPUs, starting from $399. All should be fast enough for 4K/30fps video playback, again provided you stick to H.264 and other video codecs that have iGPU acceleration support. As we mentioned earlier, Intel's latest GPU drivers for Haswell and Broadwell chips now include hybrid acceleration of HEVC (H.265) and Google VP9 – but it's apparently only adequate for 30fps content, with reports suggesting 60fps content is a struggle (**tinyurl.com/o6rralr**). Further, all other codecs will need to be software-decoded by the CPU and with only dual-core performance, the result will likely be dropped frames at 4K resolution.

If 'video playback' becomes 'gaming', keep your expectations for 4K very modest. Gigabyte's BRIX series NUCs are similar alternatives – the $529 fifth-gen GB-BXi5H-5200 with its 2.2GHz dual-core Core i5-5200U has Intel's HD Graphics 5500 GPU capable of 4K@60Hz over its mini DisplayPort output. The BXi3H-5010 features the 2.1GHz dual-core Core i3-5010U, still with HD Graphics 5500 iGPU and 4K@60Hz display output over mini-DP. This bare-bones box sells for just over $400. Be aware, however, that we can't guarantee any DisplayPort to HDMI 2.0 conversion will work if you're trying any NUC-based setup with an HDMI 2.0 4K TV.

Beware your HDMI cables

Given the bandwidth required for 4K output @ 60Hz, you'll need high-quality HDMI cabling, regardless of which build you try. If you get screen flashes or lock-ups, it could well be the cabling – don't assume your $3 HDMI cable from eBay will be up to the job.

Getting flashes on your 4K screen? Your HDMI cables may need replacing.

> "The reality is budget 4K gaming doesn't really exist yet. We've already seen that a GTX 980 is working hard to hit 50fps on most FPS titles at 4K resolution."

4K GAMING?

The reality is budget 4K gaming doesn't really exist yet. We've already seen that a GTX 980 is working hard to hit 50fps on most FPS titles at 4K resolution. A GeForce GTX 970 card will still set you back $500, for only modest 4K speed.

That said, if you have a GTX 980 gaming rig already, it might be possible to force that GPU to run at a higher resolution than its connected monitor via the driver settings and stream via Steam In-Home Streaming to your budget loungeroom box and 4K TV. There's little information on this technique and there's no guarantee it'll work – but it's something to try if you're feeling adventurous (search 'downsampling').

COMPONENT CHOICES

However, given this essentially leaves us with 4K video playback and general PC work only, here's how we'd modify our Obsidian 250D build and save around $700:

Swap the Core i5-4590 CPU for Core i5-4460 – the 4460 lacks high-end extras such as vPro and Trusted Execution, its HD 4600 iGPU also runs a little slower, but it's still quad-core. Save $20. We're not convinced Haswell Core i3 is a great idea here – wait for Broadwell, even Skylake.

Drop the GTX 980 card for EVGA's GTX 960 Superclocked ACX 2.0 – The GTX 960 doesn't have the horsepower to game at 4K, but has full hardware accelerated decoding of H.265 (HEVC) video, along with H.264, VC-1 and MPEG-2 via PureVideo. It supports HDMI 2.0 and DisplayPort 1.2 connectivity to deliver 4K @ 60Hz. The good news? At only $280, you save $550.

Swap Seasonic X-650 PSU for Seasonic G-450 – the G-450 has a slightly noisier fan but only half the cost of the X-650 and will handle the GTX 960 comfortably. Save $90.

Swap 240GB Sandisk Ultra II SSD for 120GB version – stream your content and you won't need a large-capacity SSD. Save $50.

Ultimately, a 4K lounge room PC done properly still needs relatively deep pockets, but you might be able to rig up something to get you out of trouble while the technology matures. ■

Broadwell-class Intel NUC mini PCs can deliver 4K video at 60Hz refresh rate.

The Core i5-4460 is Intel's cheapest quad-core CPU.

Media PC apps

Joel Burgess and Stephen Lambrechts share their essential picks for playing back, re-encoding and managing your media library.

As physical media continues to decline in popularity, and digital media's rise to prominence continues to take effect, finding the right software to properly play back, organise and convert media files should be on the top of everyone's list of priorities.

Having an enormous collection of media files is all well and good, but if you aren't streaming that content across all of your devices, then you simply aren't taking full advantage of it. Likewise, a library of any respectable size needs clear organisation in order to find the files you're after as soon as you feel like watching or listening to them. And, with so many file formats out there, you're going to want to make sure that your content will actually play on your chosen devices.

With these things in mind, we've put together a roundup of the best media management tools, re-encoding and transcoding software and media server applications to get the best out of all that video and audio content that's sitting on your computer.

"If you aren't streaming that content across all of your devices, then you simply aren't taking full advantage of it."

CRITICAL SPECS: Media server with live transcoding, local and remote server functionality, Windows / Mac / iOS / Android support.

FREE | WWW.AIRPLAYIT.COM

Air Playit

Simple to use, but outdated and laggy.

This software required an adjustment to our test Mac's security settings in order to run, which should be an immediate red flag.

While Air Playit's setup process is remarkably simple, immediately finding our 'Movies' folder and linking it to our newly-created media server, we found its live transcoding functionality to be lacking. Often pausing throughout playback, Air Playit struggled to get through a single minute of content when played remotely (and even locally) on its accompanying Android and iPhone apps. To make matters worse, the apps lack optimisation for new devices, with the iPhone version clearly having not been optimised since the iPhone 4 days. It's a shame, because this media server is just so easy to setup, making it one of the most user friendly options we've come across. Pity it performs and looks like an old dog.

Verdict

Simple setup is marred by horrible performance and old device clients.

★★☆☆☆

CRITICAL SPECS: Media server with live transcoding, Windows / Mac / iOS / Android / Windows Phone / Xbox 360 / Xbox One / Chromecast / Amazon Fire TV / Roku support.

FREE | EMBY.MEDIA

Emby

Feature-packed yet frustrating open source media server.

This open-source media server project recently rebranded itself as Emby in an attempt to reach a broader audience, though the average person is likely find it far from user friendly.

Bogged down by frustratingly specific file-naming conventions and a server setup process that requires intermediate computer knowledge, Emby is also hit and miss with its apps and playback. Its newly updated Android app is a breeze to setup, though we had trouble playing certain files. The iOS app however, is another story. Still titled 'Media Browser' on the App Store, the iOS version has yet to be updated, sporting an antiquated setup process that involves the entering of IP addresses and port numbers. Still, other features such as parental control, cloud sync, content sharing and Chromecast support present an impressive package, and you can't go wrong with 'free'.

Verdict

Similar in functionality to Plex, though nowhere near as hassle-free.

★★★☆☆

CRITICAL SPECS: Media center with transcoding, Windows/ Mac/ Linux.

MEDIA CENTRES/ SERVERS

US$50 SINGLE PLATFORM, US$70 UNIVERSAL
JRIVER.COM

JRiver Media Centre

A versatile ugly-duckling.

Available on Windows and Mac, this media centre can rip DVDs, organise media libraries and accept plugins for online media sources.

For the most part JRiver is set up like iTunes, allowing you to sync external devices (like a smartphone) to the media centre and transfer the files you want. If you're switching between Mac and PC and want your library in the one place then JRiver is an option... it is a little costly, but it is an option. After a 30-day free trial you can either purchase a specific OS licence (US$50) or a master licence (US$70) which will allow you to download the software on Mac, Windows and Linux. JRiver is more versatile than iTunes allowing you to transcode files and access them through a server but, all-in-all, you do sacrifice presentation for customisability.

Verdict

Not a bad media organiser and re-encoder, but not exceedingly impressive either.

★★★☆☆

CRITICAL SPECS: Free, open source media centre with PVR and metadata scraping Windows / Linux / Mac / Android / Ubuntu/ RasberyPI and more.

MEDIA CENTRES

FREE | KODI.TV

apc HOT PRODUCT

Kodi

Impressive, free and open-source software.

Kodi began as a media centre for the Xbox and was known as XBMC until late last year. These days it's almost compatible with everything.

At its core Kodi, is a media library that aggregates all the media files you have and allows you to orchestrate quick-access pathways using a remote interface. Various additional plugins allow further customisation for things like streaming services, TV, skins and even games. Though it doesn't have an internal TV tuner, it does support thirdparty PVR plug-ins, with both EPG and HD digital video recording support. One of the best aspects is the automatic collection of information about the titles you have; Kodi will add cover images and synopses to your films and TV shows. Overall, an extremely customisable media library with decent plug-ins that give you access to online streaming services. It's hard to bypass.

Verdict

An unparalleled free media centre available on most platforms.

★★★★½

CRITICAL SPECS: Media management and transcoding, device syncing, supports MP3, AAC/ M4A, OGG, WMA, MPC, APE, FLAC, WAV, WMV, AVI, MP4, MKV file formats.

apc HOT PRODUCT

MEDIA CENTRES/ SERVERS

FREE OR GOLD FOR US$24.90
WWW.MEDIAMONKEY.COM

Media Monkey

Despite the name, this management tool ain't monkeying around.

Keeping track of all of your music and video files can be an exhausting task. This is when a management tool like Media Monkey proves invaluable.

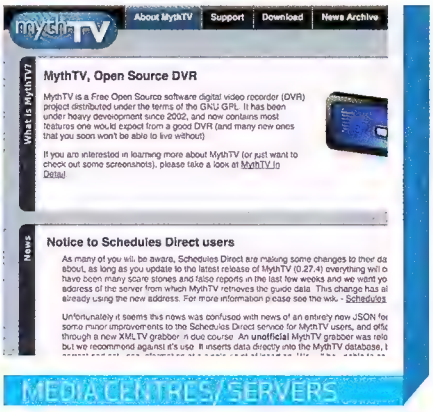
Currently only available for Windows, it takes your files and organises them, applying tags to MP3s, identifying tracks, renaming files, creating folders, managing playlists and syncing your files to a range of compatible devices, including iOS and Android phones and tablets. And, if your TV or Blu-ray player has a DLNA server, you'll be able to stream Media Monkey's library with its ability to transcode on the fly, though that functionality is only in the Gold version. You can also use Media Monkey to burn backup copies of your media to disc. Easy to use, yet full of extensive customisation options, Media Monkey puts most other media management tools to shame. Now if only there were Mac and Linux versions available...

Verdict

A fantastic media management solution with added streaming features for good measure.

★★★★½

CRITICAL SPECS: Media server back end with customisable add-ons, Linux/ Mac.



MEDIA CENTRES/SERVERS

FREE | MYTHTV.ORG

MythTV

A true DIY open-source media server.

If you have an old PC and are looking to make your own version of Tivo, an option that may not have crossed your path is MythTV.

This free open-source alternative to Serviio and Plex,established its roots in Linux, and has since been ported to Mac. And if you're really determined you can even build Myth TV on Windows, but a pre-built package is not yet available. That said, even on a Mac or Linux system, MythTV is more complicated to set up than any of the other media servers or centres tested here. The back-end offers an unparalleled amount of customisability, but the front end isn't all that appealing and you'd probably be better off running it through something like Kodi. If you don't mind fiddling in the command line then MythTV will pay dividends, but it's a long way off being user friendly.

Verdict

A dense but highly customisable media server.

★★★☆☆

CRITICAL SPECS: Media server with live transcoding, Windows / Mac / iOS / Android / Windows Phone / Xbox 360 / Xbox One / Playstation 3 / Playstation 4 / Ouya / Chromecast / Amazon Fire TV / Roku support.

apc HOT PRODUCT

MEDIA CENTRES/SERVERS

FREE OR PREMIUM FOR US$4.99 A MONTH
PLEX.TV

Plex

The world's leading media library solution.

Arguably the world's most highly-regarded media library solution, Plex creates a server on users' computers that can be accessed from anywhere.

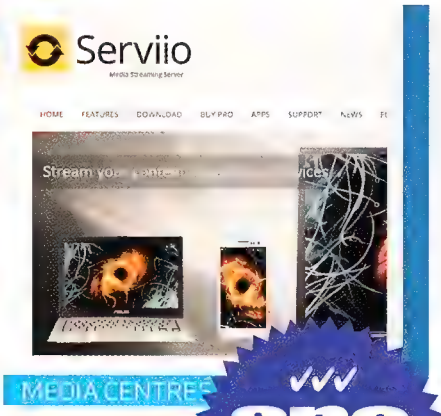
This is due to Plex's huge range of supported platforms, including iOS, Android, Windows Phone, Xbox 360, Xbox One, PlayStation 3, PlayStation 4, Ouya and Chromecast, as well as other platforms like Amazon Fire TV and Roku. Once you've spent some time setting up your library, you'll be able to login and start playing your movies and other files. That said, you'll need a Plex Pass premium account in order to stream your content to any of the game consoles listed above. Perhaps the best thing about Plex though, is its interface. Your content is presented with information and cover art, and show-specific themes pulled straight from the web. Plex is undeniably at the top of its game.

Verdict

Terrific functionality, a huge range of supported devices and a fantastic interface make Plex a leader in its field.

★★★★½

CRITICAL SPECS: Media server and transcoder, Windows/ Mac/ Linux/ Synology NAS; DLNA compatibility includes smart TVs, Blu-ray players and consoles (Samsung, Sony, Panasonic, LG, Toshiba, Sharp, Philips, WDTV, Oppo and both PS3 and Xbox consoles are compatible).



MEDIA CENTRES

FREE / US$25 PRO
SERVIIO.ORG

apc RECOMMENDS

Serviio

A solid free option for streaming to smart TVs.

If you've already cut your teeth on a few media servers and are looking for something like Plex that can transcode media from your PC and shoot it to any playback device on-the-fly, then Serviio may just be what you're after.

More complicated than some others here, the base program is free and pretty good at what it does. If you're only streaming to your smart TV or Blu-ray player then Serviio works perfectly well and won't cost you a thing. There isn't too much out there in the way of tutorials, but a bit of tinkering will generally lead to a working server. If you have an Android phone or want to get at your media files through a web-browser you will have to fork out for the Pro edition and, unfortunately, there aren't any playback apps for iOS or Windows Phone yet.

Verdict

A great media server with comprehensive livingroom compatibility.

★★★★☆

CRITICAL SPECS: Transcoder, Windows.

FREE | FREEMAKE.COM

Freemake Video Converter

Proceed with caution.

This streamlined video converter has a front-end that replaces the numerous selection toggles found in Vidcoder (right) with buttons for simple actions. It's designed for the entry-level video converter, so most of the customisable features have been stripped out.

Adding video, audio, DVDs or pictures, just requires you to click an appropriate button and open the video file you are looking for. A handy drag and drop feature also gives you the option to throw URLs directly into the lineup. Additionally, it has a really basic video editor. Freemake successfully achieves what it sets out to, however, we advise some caution. This program is not open source, yet it's free. With, no ad popups, there is a question about how it's making money and there's been reports of the app containing hidden web browser adware. Beware.

Verdict

The app runs well but there are some questions regarding its integrity.

★★☆☆☆

CRITICAL SPECS: Video encoding, Windows / Mac / Linux, File containers: MP4, MKV, Video encoders: H.264, H.265, MPEG-4, MPEG-2, VP8 and Theora, Audio encoders: AAC, MP3, Flac, AC3, and Vorbis.

FREE | HANDBRAKE.FR

HandBrake

A free and reliable open-source video transcoder.

While many media server options do a decent job of transcoding on the fly, various factors on your network can affect the quality of your playback.

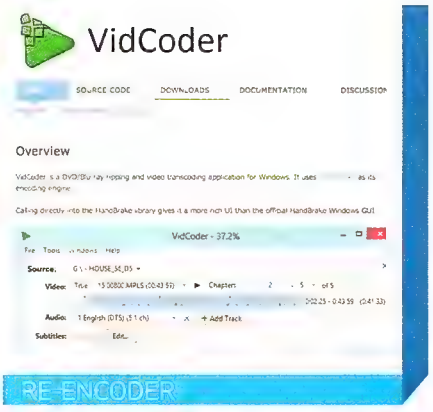
When live transcoding doesn't quite cut it, a good alternative is to convert your files into formats that your devices can process natively. HandBrake has long been a trusted solution in that regard. Its simple user interface lets you select your source file, choose the format to convert it to and hit 'Start'. To simplify the process, HandBrake offers presets to ensure your file will play on your desired device. The Output Settings also let you select specific video codecs, bitrates, framerates, filters and other advanced options. Transcoding your files will take time, though. Thankfully, HandBrake lets you create a queue of items, so you can focus on other things... like drinking fruity cocktails.

Verdict

A great, free transcoding solution to take care of all of your media conversion needs.

★★★★☆

CRITICAL SPECS: DVD ripper and transcoder, Windows.



FREE | VIDCODER.CODEPLEX.COM

Vidcoder

Slightly simpler than Handbrake.

If you want to flick media to any device you're going to need something to transcode videos on the fly. Handbrake is a great tool for ripping your DVD collection but can be a little daunting.

Vidcoder draws from Handbrake's features but presents it in a slightly more approachable way. Vidcoder can pull media from a DVD and format it for everything, adding in subtitles, chapters and other peripheral info as it goes. Unfortunately you will need to be running Windows 8 (or Microsoft's .NET 4.0 framework on Windows 7), so if you're using Mac, Linux or something else you'll have to use HandBrake. If you only plan to rip your DVD collection to your media library, then Vidcoder is a streamlined option that works well. That said you'll still need to read a tutorial or two before using Vidcoder if you're unfamiliar with how re-encoding programs work.

Verdict

Not simplified enough to be a decent alternative to HandBrake.

★★★☆☆

Stream your flicks to any device

Plex is a beautiful way to stream your videos and music to your TV, PC, phone, tablet and more. Simon Chester

There are many ways to consume media – that is, movies, TV shows, music and so on – on your big screen and speakers. From your Xbox, PlayStation, Apple TV, Chromecast, Boxee, WD TV and any of the lesser-known media devices out there, people have been streaming digital media files to their TV in many different ways for over a decade.

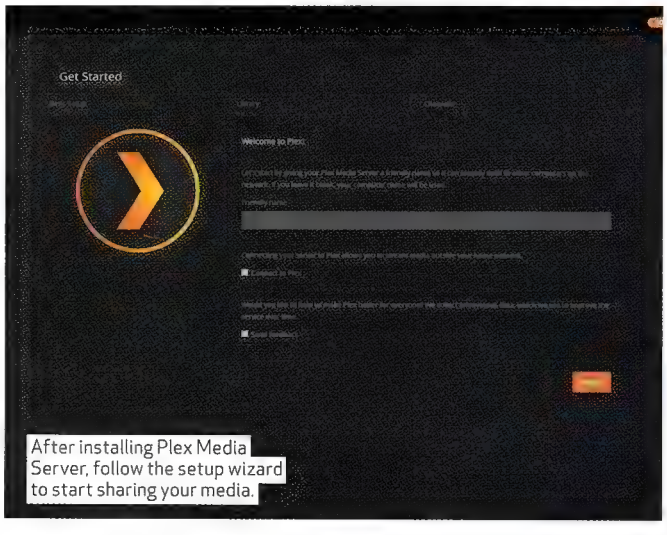
However, there is one method that more than one *APC* staffer believes offers not only one of the most attractive interfaces, but seamlessly and simply unifies all of your different TVs, computers, phones and tablets – allowing you to watch all of your media on any of them, no matter where you are. And that's Plex.

Plex is a freemium service that has its roots in the open source Kodi (formerly XBMC aka Xbox Media Center), but brings its advanced features (such as maintaining a central media library across devices, or converting media for use on otherwise incompatible devices) to those without the time or knowledge required to get them working.

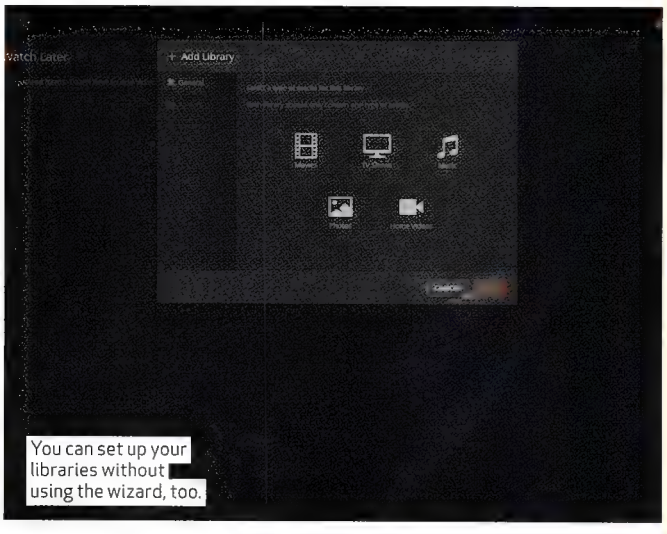
What it allows is for you to have a central server/PC stored somewhere in your house that contains all of your music and movies, which you can then access on myriad devices, including your Xbox/PlayStation, any Windows, Mac or Linux PCs/laptops, or any phone/tablet – even when they're out on the road.

Having the media accessible isn't the whole picture, though: what really makes Plex special is its interface. Just like with Kodi, Plex scans your media files and then retrieves rich metadata for them, so that your movies and TV shows are viewed using posters and recognisable art work, as well as being browse-able/searchable by year, watched/unwatched status, genre, actor/actress, director, and more. This all feeds into an attractive interface that will make choosing your next flick a breeze. You can even discover new content under the 'Discover' tab, which will recommend content based on your viewing habits, or just by going to a movie you love and clicking on the director or other cast/crew member to see what else is available in your library with/by them.

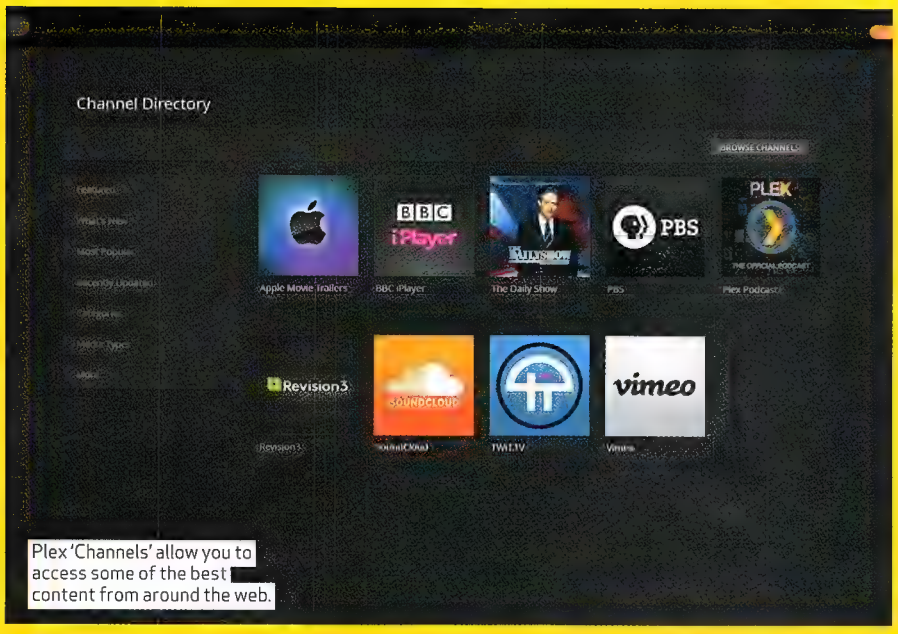
Further to this, you can use the Plex app on your phone to control the Plex version running on the device hooked up to your TV – giving you a touch interface, rather than the often painful



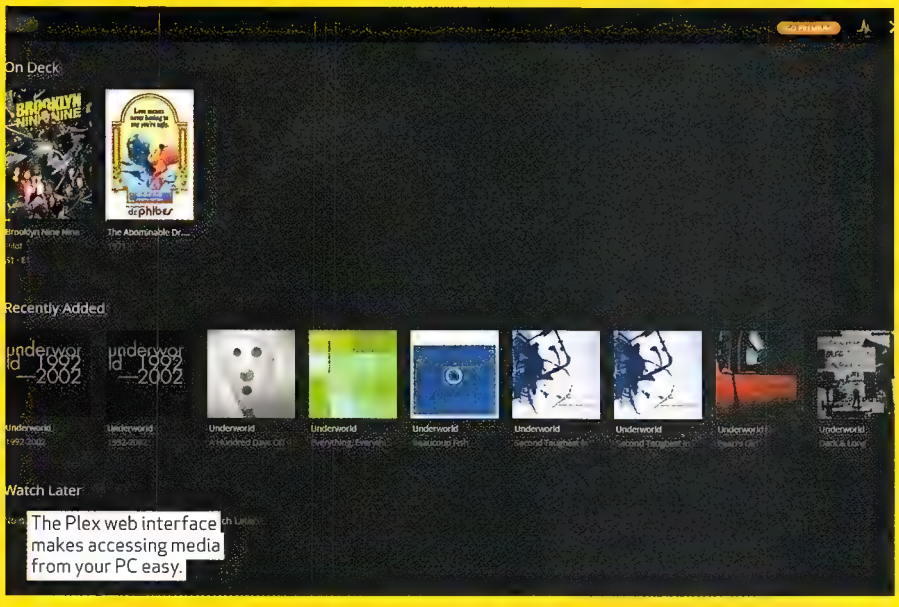
After installing Plex Media Server, follow the setup wizard to start sharing your media.



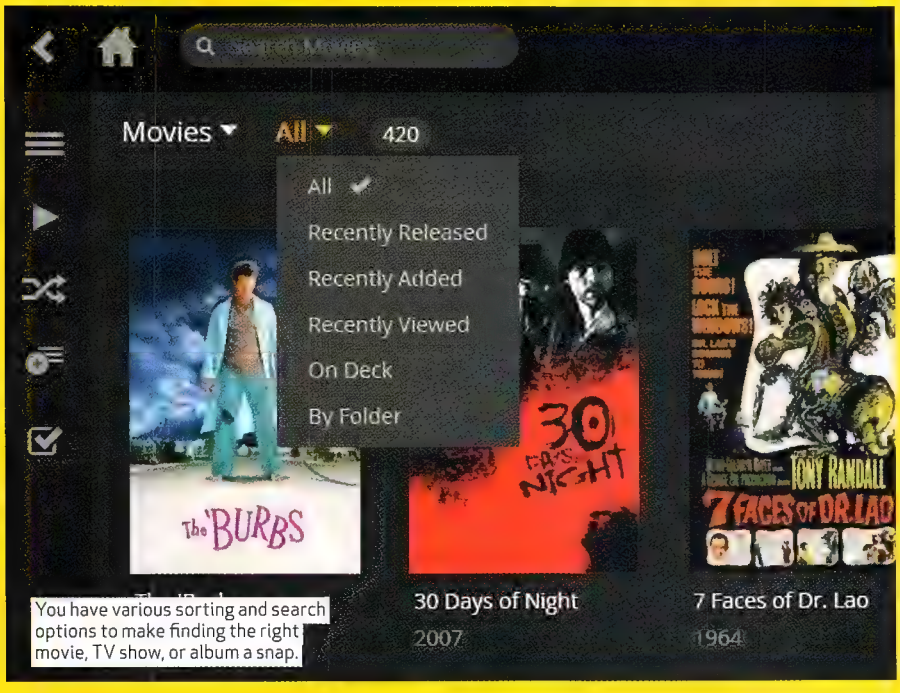
You can set up your libraries without using the wizard, too.



Plex 'Channels' allow you to access some of the best content from around the web.



The Plex web interface makes accessing media from your PC easy.



You have various sorting and search options to make finding the right movie, TV show, or album a snap.

keyboard-and-mouse/TV remote interface so often associated with home theatre PCs.

And, because Plex's database is stored on a central server (your PC running the Plex Media Server application), it means that you can stop a movie or TV show on your TV, and then pick it up again in your pocket or in another room. You can even set up multiple users within the house, so that you can keep track of what episode you're due to watch next, or restrict the content that specific users have access to based on rating or library location.

You also have the option to share your media with friends and family, if you want them to share in the joy of what you're watching or listening to, without having to actually watch or listen to it with them. Obviously, sharing a whole season of a TV show is entirely impractical, but this does serve as a handy way to send quick recommendations to friends that also have Plex, as every app or interface comes equipped with share buttons.

Speaking of buttons (poor segue, we know), one of the handier features that Plex offers is a bookmarket that you can install in your browser (mobile or desktop), that will add the current video or audio that you're enjoying from a streaming service like YouTube or Vimeo to a 'Watch Later' section in Plex. This is particularly handy for quickly moving something from your tiny screen to your TV.

PLEX PA$$

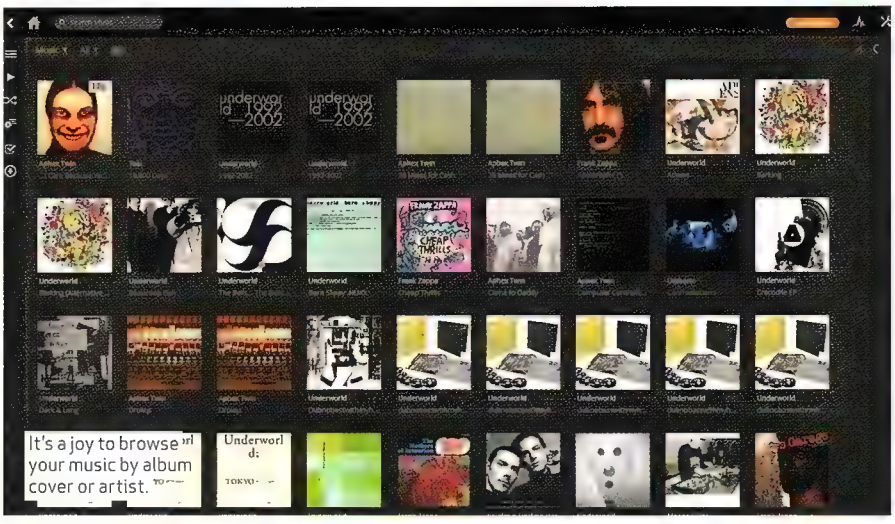
Now, as we mentioned before, Plex is a 'freemium' service. That is, you can use it for free, but if you want some of its handiest features, you're going to have to fork out for a subscription (either US$5 per month or US$40 per year) or a once-off, lifetime pass fee of US$150.

What do 'Plex Pass' subscribers get access to?

Superficially, you'll have – in addition to the movie posters, synopses, and other information – movie trailers and other extras accessible from your library, which can actually be a blessing when navigating large video libraries full of movies that friends have recommended over the

Plex on your console

To learn how to install Plex on your Xbox 360 or Xbox One, visit **plex.tv/xbox**. And for installing on PS3 or PS4, visit **plex.tv/playstation**. Unfortunately for tightwads, you'll need to be a Plex Pass subscriber to access these apps.



Plex on your Raspberry Pi

Proper geeks can use a Raspberry Pi as a Plex playback device (not server) using RasPlex, which is free from **rasplex.com**.

years. And with so many movie trailers in your library, you can even activate an option to show a specified number of movie trailers (either those from your library or upcoming/new releases) before your chosen movie, which really puts the 'theatre' in home theatre.

More practically, Plex Pass subscribers also get the ability to copy movies/TV shows to their tablets for offline viewing, move selected media to Google Drive, Dropbox, or Box (allowing it to be accessed when their home PC is turned off), have free access to the Plex Android, Roku, VIZIO, Xbox, and PlayStation apps, get automatic syncing/backup of your phone/tablet photos to your server, and can use the aforementioned user accounts within your household.

It is definitely worth noting, though, that Plex is a very capable product even without subscribing to a Plex Pass.

PLEX MEDIA SERVER

At the heart of Plex is the Plex Media Server, which is best installed on an always-on PC, server, or compatible NAS (network attached storage) device. The server is what indexes your files, downloads the artwork, synopses, and other information, as well as does all the behind-the-scenes transcoding to make sure that the videos and audio will work on the playback device that's requesting them.

So, if you're looking to get in on the Plexiness, you need to first install the Plex Media Server. Now, before doing that you should also register for a Plex account at **plex.tv** (even if you're not looking to become a subscriber), and then verify your account by following the link in your registration email (this author didn't verify his account before first running Plex, and it hung on first load – we suspect because it was trying to attach to our account, but can't be sure). Now it's time to download and install Plex Media Server.

Plex Media Server can run on Windows, Mac, Linux, various NAS boxes, and even FreeBSD. You can download it for free from **plex.tv/downloads**. The main interface of the app runs from a web-browser, making it a cinch to manage, even when installed on that dusty server tucked in the dank depths of your basement.

On first accessing the web interface (located at **plex.tv/web/app**), you should just follow through the wizard process, where you will name your server, tell Plex where your media resides, then install some channels for online content (some of which won't be available in Australia unless you're using a VPN).

If, like us, you need to set up Plex manually, the first thing you have to do is tell it where your media resides.

Plex divides itself into several libraries, each of which contains a single type of media, such as movies, TV shows, or music. To manually set up each of your libraries, click on the home icon and – next to the name of your server – press the + button, select the type of media you wish to add, then tell it which drive and folder it lives in.

To watch any of the movies or TV shows located on your server, you simply choose the media type from the list on the left, find the movie or TV show that you're interested in from the list of thumbnails (you can re-arrange them by release date, add date, viewed date, in progress, or folder by pressing the 'All' drop-down menu up top), and hit play – it all happens from within your browser.

As you watch media, you'll notice a new section appearing on the Plex

home screen – 'On Deck.' This is simply a list of any movies or TV shows that you started but didn't finish watching, as well as – for TV shows – the next episode in the season that you're currently making your way through.

You'll also have noticed a 'Channels' section. In Plex terms, channels are media streams from across the internet – from interesting shows, clips, and documentaries, to podcasts and music streams. If you want to install more channels, or didn't set any up during the wizard, you simply navigate to the Channels section under your server name, then choose 'Install Channels' on the right hand side.

Once you've set up your server, you need to install the Plex apps on your mobile devices. On a side note, to access Plex on other computers connected to the same network, you can just visit **plex.tv/web/app** and sign in with your Plex account – everything is there waiting for you.

PLEX DEVICES AND APPS

As mentioned, Plex is available on Android, iOS, Windows Phone, Xbox, and PlayStation (among others). The Xbox and PlayStation apps are probably the best way to get it to your TV if you already own one of those consoles, but if you don't, you can always hook up an old PC or mobile device (with an HDMI out dock or cable). Each of the mobile apps can serve as a remote control, too, so you needn't even worry too much about hooking up a keyboard/mouse.

Another alternative is to use a $50 Chromecast or $110 Apple TV, as the Android, iOS, and desktop interfaces all natively support both casting and AirPlay – just hit the appropriate icon when playing or selecting media from your mobile device.

In addition to the device hooked up to your TV, you'll probably also want Plex on your phone and tablet. Somewhat perplexingly, the pricing of apps changes per platform: on Android, the app is free to download, but you can only use it as a remote and to consume media in 1 minute blocks, unless you're a Plex Pass subscriber, or you shell out a ~$6 in-app unlock fee. On iOS, the app costs $6.49, even if you're a Plex Pass subscriber. Likewise, Plex for Windows Phone or Windows 8 costs $4.99, and – again – isn't free for Plex Pass subscribers, but you only need to purchase it once to install it on your PC as well as your handset.

The layout for all the different Plex apps is basically the same – whether it's Android, iOS, Windows Phone, Xbox, or PlayStation. That is, they are divided up into the following sections: On Deck; Recently Added; Library; Shared Libraries; Playlists; Channels; Watch Later; and Recommended.

> "It's worth diving into the settings section of each app (including the desktop/server app), as you'll find a host of handy options."

Kodi as an alternative

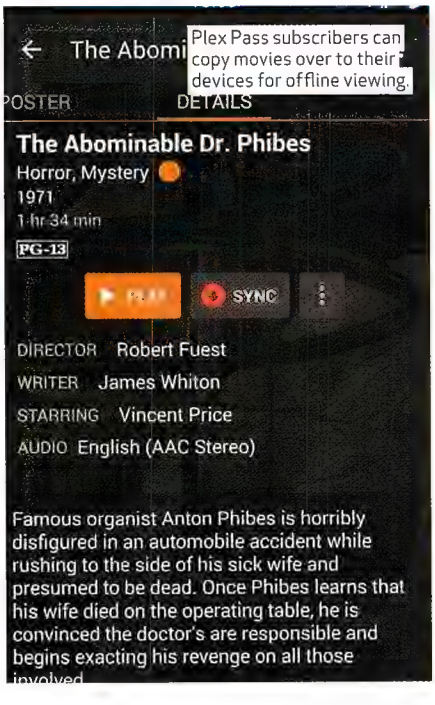
Plex is actually based on the open source Kodi (formerly XBMC), and there isn't much that Plex can do that Kodi can't — not without a bit of brain grease and some nerdery, that is. If you're not afraid of such things, dive into the Kodi wiki at **kodi.wiki**.

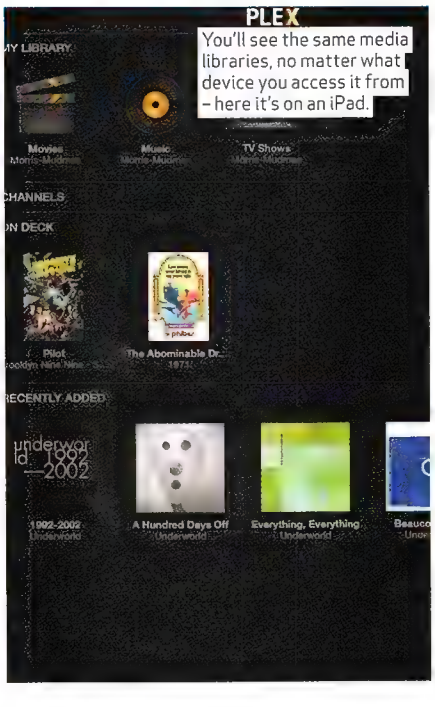
One really handy feature in the mobile apps is the ability to (optionally) make the photos, music, and videos stored on your mobile device available on other Plex devices around the home – a really great way to show your latest holiday snaps off to your bored relatives.

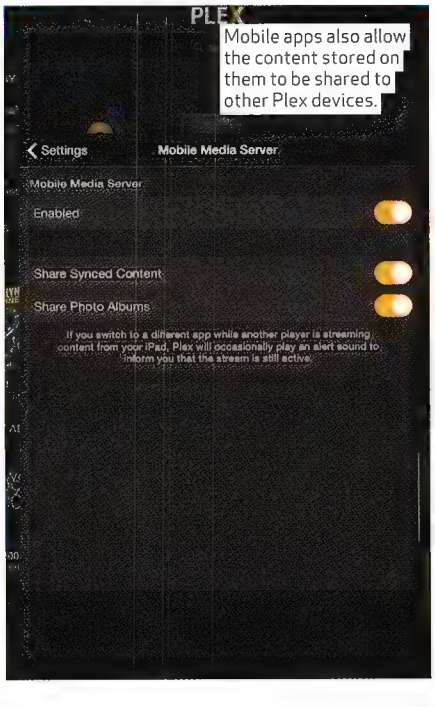
It's worth diving into the settings section of each app (including the desktop/server app), as you'll find a host of handy options, from remedies to fix playback issues when streaming content ('Settings > Video' and drop the quality a little), enabling/disabling the automatic upload of your phone camera photos to your home server ('Settings > Camera upload'), to options to enable/disable/change the number of trailers that screen before a movie ('Settings > Experience').

Also worth noting, if you're using an Android device over HDMI for playback, is the option to switch from the phone/tablet interface to one suitable for TVs ('Settings > General > Application layout').

Now it's just time to kick back on your couch, train seat, or porcelain throne, and enjoy a movie or two. ■







Comfy couch controllers

Nathan Taylor tracks down the best devices to control your media centre PC from your lounge.

One of the most crucial – and often overlooked – elements of any media centre setup is the control devices. A standard mouse and keyboard setup aren't going to work, since you probably don't have a surface to use them on. Instead, you're going to have to look to game controllers, wireless keyboards and touchpads and remote controls for Windows.

Smartphone or tablet as remote?

There's an app for that...

It's absolutely possible to set up your mobile as a controller for your 4K media centre, and there are a number of ways to pull it off.

The smoothest is per-app controls. Many apps have Android and iOS remote controls, and setting it up is usually as easy as downloading the app from the app store and connecting it to your media centre PC.

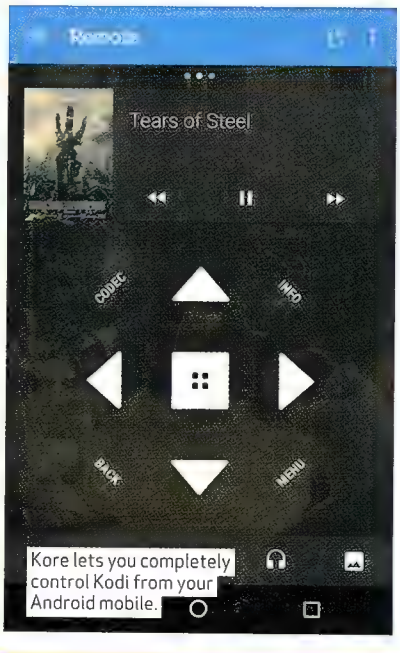
If you're running Kodi, for example, you should absolutely download Kore for Android from Google Play. Kore is the official remote controller for Kodi, and it lets you both control it like a remote (with arrow and select keys) and browse the library and launch media directly. There are similar apps for Plex: Plex for Android/Plex for iOS.

If you have an IR Blaster in or attached to your phone, there are a number of apps you can download that will turn your phone into an IR remote (obviously, you also need an IR receiver on your PC for this to work). The Smart IR Remote — AnyMote app works well. It's designed for use with the AnyMote Home (**anymote.io**) external IR blaster, but it will work with inbuilt IR blasters as well.

You should also check out Remote Control Collection, an app available on the iTunes App Store and Google Play. The free version allows your mobile to work as a keyboard and mouse (touchpad) for your PC. You need to install the Windows server app from **remote-control-collection.com**, and then you just install the app on your mobile. It's really simple and works quite well — it even supports speech recognition. The Pro version also supports remote desktop, but you can get remote desktop for free with Chrome Remote Desktop.

Chrome Remote Desktop (which is even available for iOS, despite being a Google app) allows you to mirror your desktop on your mobile and control it. It's similar to Microsoft's Remote Desktop, but doesn't require the Pro version of Windows. On your PC you install it from the Chrome Web Store in your Chrome browser; on your mobile from Google Play or iTunes.

Although it technically works for 4K, it's not something we'd necessarily recommend. It's pretty painful to use — the bandwidth and processing requirements are extreme, and at that resolution screen elements like buttons and menus tend to be tiny and impossible to press on the mobile or tablet screen. Still, it might work for you and there's no harm in trying!



Kore lets you completely control Kodi from your Android mobile.

GAMES CONTROLLER

$50 | WWW.LOGITECH.COM

Logitech F710 Wireless Gamepad

It's like a PS3 controller for Windows.

Compared to the primarily console-focussed controllers here, the Logitech F710 is built for PC gamers. It has a tiny (tiny) USB wireless adapter and works very well in most games that support game controllers, since it supports the common XInput/DirectInput standards.

In terms of layout and design, it's most like the DualShock 3 of the PS3, with similar too-floppy control sticks and dual vibration controller. It does use Xbox-style button labelling, which makes sense since most Windows games are designed to work with the Xbox 360 controller.

It's a perfectly serviceable controller, and cheaper than most of its competition. We prefer the tighter controls of the other controllers here, but if you love the PS3 controller best, this might be a good option for you.

Verdict

A solid but uninspired controller.

★★★☆☆

GAMES CONTROLLER

$60 | WWW.MICROSOFT.COM.AU

Microsoft Xbox 360 controller

A gamepad that just works.

The Xbox 360 controller is absolutely the gold standard for PC game controllers. It's arguably superior to the Xbox One controller and it works perfectly with Windows games. In fact, it's kind of the target device for most games, since it's the most popular games controller for the platform.

There are two versions of the Xbox 360 controller – a wired and wireless version. The wired one simply plugs into a standard USB 2.0 port. The wireless model uses a USB dongle as the receiver – if you buy the official "Xbox 360 Wireless Controller for Windows with PC USB Adapter" bundle it comes in the box, but if you have a stand-alone Xbox 360 controller (perhaps from an old console) you'll need to purchase the PC USB adapter separately.

Verdict

The de-facto standard — and with very good reason. An excellent controller.

★★★★½

GAMES CONTROLLER

$85 | WWW.RAZERZONE.COM

Razer Sabertooth Elite Gaming controller

A souped up, non-wireless Xbox 360 controller.

At first blush, the Razer Sabertooth looks very much like a clone of the wired Xbox 360 controller, with the same button and controller layout and almost identical moulding. A closer look, however, reveals that it has a few extra tricks up its sleeve, including six additional buttons (two on the shoulders, four underneath) and a small OLED screen that displays its current configuration.

Using the supplied software, you can assign custom functions to these buttons, which can be a major boon in a PC gaming scenario. It also has a 3.5mm mic jack, so you can more easily scream abuse at your teammates in *Counter-Strike* and *League of Legends*.

Still, it largely functions just like an Xbox 360 controller, which means that a lot of action and platform games work seamlessly with it.

Verdict

A modest improvement on the Microsoft controller, but more expensive and only wired.

★★★★☆

GAMES CONTROLLER

$80 | WWW.PLAYSTATION.COM

Sony Playstation DualShock 4

A great controller – if you can get it to work.

Sony has never released official Windows drivers for the DualShock 3 and 4 – it considers them PlayStation exclusives and isn't interested in helping you use them on a PC. But it is possible – if you're prepared to put up with a bit of hackery. The good news is that they can pair with standard Bluetooth controllers or can be connected by USB directly to the PC.

For the DualShock 4, you'll need to first install the Xbox 360 drivers. Then head to **forums.pcsx2.net/Thread-DS4-To-XInput-Wrapper** and download and run the DS4Tool, which tricks the computer into thinking your DualShock4 is an Xbox 360 controller. (A similar tool for the DualShock 3 can also be found at **pcsx2.net**). We've found it works pretty well (and love the ability to control the cursor with the touchpad), though this software is both in beta and unofficial.

Verdict

It's a fantastic controller, but you need to jump through a few hoops to get it to work.

★★★½☆

REMOTE CONTROL

$15 | AIMPRO21.COM

aim/8WARE Media Center Remote Control for Windows 7

A low-cost, basic option.

In spite of the "Windows 7" branding, the aim/8WARE Media Center Remote will work with any version of Windows – it is, after all, just a standard low-cost Windows Media Center Remote.

It comes with a small IR receiver in the box, as well as a USB extension cable so you can more easily place the receiver where the signals might best reach it.

Although we appreciated the solid build of the remote, we weren't in love with the quality of the buttons. They're too hard and too small, and don't make for a particularly comfortable experience, especially for blind control, where the uniform size of the buttons make it hard to figure by feel which one you're pressing.

Still, it's a cheap option and it worked perfectly with Plex and Kodi.

Verdict

It's cheap and gets the job done, but don't expect premium quality.

REMOTE CONTROL

$50 | WWW.HAUPPAUGE.COM

Hauppauge Media Center remote

An old stand-by.

Hauppauge's MCE remote has barely changed in a decade, but it really hasn't needed to. It's a comfortable moulded remote, with pleasantly spongy buttons and supplied with a rather large IR receiver on an extended USB cable. The last is very useful; it's not that discrete, but it's easy to place in a position for reception without having the weight of the USB cable pull it out of position.

The remote was originally supplied with Hauppauge TV tuner products, but is also available stand-alone, albeit at a price that's rather too high for what's on offer.

Still, it's a good remote, easy to use by feel and durable enough to last through heavy use.

Verdict

Too expensive, but it is a nice remote.

REMOTE CONTROL

$40 | WWW.LOGITECH.COM

Logitech Harmony 350

A fantastic programmable remote.

The Harmony 350 is not natively a Media Center remote – but it can be turned into one. Like the rest of the Harmony range, it's a programmable universal remote. You plug it into a USB port and run the Logitech Harmony software to program its functions. Up to eight remote schema can be programmed, one of which can be a Windows Media Center remote. You could also program it to control your 4K TV or screen, if your 4K screen has IR controls.

It's a beautiful remote as well, with fine comfortable buttons and solid feel.

All that said, the Logitech does not come with an IR receiver, which means that you'll have to acquire one from elsewhere. It should work with any receiver, including ones supplied with other Media Center Remotes.

Verdict

It takes a bit more work to get it to function, but it's worth it.

COUCH KEYBOARD AND MOUSE

$100 | WWW.LOGITECH.COM

Logitech Illuminated Living-Room Keyboard K830

A fantastic but pricey full size keyboard.

A full sized keyboard with built in glide pad, the K830 is certainly at the premium end of the scale. It has a pretty hefty price tag, but if you're building a full 4K system you just might want to go all out.

And it is pretty fantastic, with a beautifully tight keyboard with backlit keys for use in the dark. The touchpad on the right has excellent feel and control, akin to the best laptop touchpads. You're not going to be playing games with it, of course, but it beats most such pads.

It's powered by an internal USB-rechargable battery, which Logitech claims will last for 10 days of relatively heavy use. It talks to the PC via logitech's universal receiver, one of which comes with the keyboard.

Verdict

If you're prepared to go all-out, this is a top choice.

★★★★☆

COUCH KEYBOARD AND MOUSE

$35 | WWW.MICROSOFT.COM

Microsoft All-in-One Media Keyboard

A simple, functional design.

Like the Logitech K830, the Microsoft All-in-One has a full size keyset accompanied by a touchpad on the right hand side for mouse control. It doesn't have the premium feel or lighting of the Logitech, but it is available at less than half the price.

In terms of looks and design, it's actually about as plain as you can imagine, but the keyboard feels quite solid in use, suitable for extended typing sessions. It's in the capacious glide pad that the Microsoft keyboard really shines, however. It's smooth, responsive and more than large enough. It's certainly not as fancy as the Logitech, but if you want something that just works, the Microsoft All-in-One Media Keyboard is pretty great.

Verdict

No frills, but it's cheap and works a treat.

★★★½☆

COUCH KEYBOARD AND MOUSE

$40 | WWW.ENCOMTECH.COM.AU

Rii mini i8 RT-MWK08

A great mini-keyboard and touchpad.

For such an affordable device, the RT-MWK08 is remarkably well designed. It's a mini keyboard and touchpad combo, and while we wouldn't play games or type essays on it, for the occasional Netflix search, web address entry or pressing OK on Windows prompts it's pretty much perfect. The keys are tight and provide good feedback, and the touchpad, while a little small, works smoothly.

The device itself is about the size of your open hand, designed for mobile-style thumb-typing. There are multimedia controls built in as well as quick access buttons for Windows. It uses a tiny USB dongle that fits inside the keyboard when not attached to a PC, and is powered by a rechargeable lithium battery.

Verdict

A bargain for the price.

★★★★☆

Easier wired networking

Your wireless network not cutting it for 4K video? Try the powerline networking gear Nathan Taylor tested.

4K video requires a lot of bandwidth. We mean a lot. Even if you're streaming it from your own home server or NAS rather than over the internet, you may run into bandwidth issues on your local wireless network.

For a high quality 4K stream, such as one captured by a 4K home video camera, you likely need 30-40 megabits per second (that's 4-5MB/s). Even at the higher end of the compression/lower end of the quality scale, you need 15+ megabits per second. Netflix, for example, encodes its 4K video at 15.6Mbps, which is a very high compression rate. YouTube varies quite a bit, but it generally works at 10-20Mbps.

Can your Wi-Fi network sustain that? And we mean sustain, as in never dropping below that rate. It's certainly possible, even on 802.11n, but in reality many home Wi-Fi connections will struggle, and you'll see frequent buffering pauses or frame skipping. And of course, don't try to stream more than one thing at a time over it.

That's where powerline networking (AKA HomePlug AV2) comes in. Homeplug devices use your home electrical network to transmit data, sparing you the need to run full Ethernet cabling but still delivering wired speeds and, more importantly, wired consistency. Unlike Wi-Fi, where throughput typically fluctuates wildly over time, powerline tends to produce very consistent results. The only times you might see dips or troughs is when some device in your home throws a bunch of extra noise onto the electrical cabling (dryers and heating appliances are the most likely culprits).

Speeds will vary, depending on the quality of your home electrical network, the distance between devices and the standard supported by the HomePlug device. At the time of writing, 200Mbps, 500Mbps and 600Mbps devices were common. As with most networking, actual throughput is quite a bit lower: expect to get quite a bit less than half of that in real world conditions.

Unfortunately, it turns out we decided to run this review at an awkward time. By the time you read this, the first few 1Gbps and 2Gbps devices should have hit the market in Australia, and it may be worth looking out for them. These devices use multiple input/multiple output (MIMO) techniques similar to those used in Wi-Fi to multiply the number of streams beamed through the electrical cables. One of the first devices to come out, the D-Link DHP-701AV is rated for 2Gbps. Netgear has a device (the PL1200) rated for 1200Mbps. Both of these may be available right now, but were not available in time for review in this issue.

HOW WE TESTED

For all the adapters reviewed here, we used a simple file transfer test, copying a 2GB file from an SSD on a server PC to another SSD on a client. The results are listed in MB/s.

We ran the test at two ranges, with "range" measured by running a tape measure along the walls between the devices rather directly. This is used to roughly indicate the length of electrical wiring the signal had to traverse. The results in the table are for short range (roughly 10m wall distance) and long range (25m).

Much like wireless tests, these results are mostly useful as a comparative measure, and do not necessarily indicate the kinds of results you'll get in your home. Depending on the quality and arrangement of your home electrical wiring, as well as the other devices you run in your home, you may get different results.

POWERLINE RESULTS

	SHORT RANGE (10M) MB/S	LONG RANGE (25M) MB/S
BILLION BIPAC P108	15.15	5.7
EDIMAX HP-5103K AV500 NANO POWERLINE ADAPTER KIT	6.82	4.49
D-LINK DHP-309AV POWERLINE AV500 MINI NETWORK STARTER KIT	7.22	4.63
NETCOMMWIRELESS 600MBPS POWERLINE KIT WITH GIGABIT ETHERNET - NP507	17.87	6.94
TP-LINK TL-WPA4220KIT 300MBPS AV500 WIFI POWER-LINE EXTENDER STARTER KIT	6.4	5.61

CRITICAL SPECS: 600Mbps powerline, 1000Mbps Ethernet

$126 | WWW.BILLION.COM.AU

Billion BiPAC P108

A high-performance device.

Like NetComm Wireless, Billion saw the value in using Gigabit Ethernet ports rather than older fast Ethernet ports in its AV500 powerline adapter, and it shows in the short range test results.

Where the other devices are hamstrung by the limitations of 100Mbps Ethernet, the Billion can achieve its full potential at any range.

As a result, its short range test results are far better than most of the competition. At long range, where Ethernet is not the limiting factor, its performance was more in line with the other units tested this month.

Other than its Gigabit port, however, the BiPAC P108 is about as vanilla as you can get. It's chunky, likely crowding out its partner on a double power point, and there's but a single Ethernet port in each adapter.

A sync button lets you very easily add additional adapters to the network though, so that's a plus.

Verdict

Solid performance from a device that doesn't fall into the Fast Ethernet trap.

★★★★☆

CRITICAL SPECS: 500Mbps powerline, 100Mbps Ethernet

$62 | WWW.DLINK.COM.AU

D-Link DHP-309AV

A device hamstrung by its Ethernet port.

Like the Edimax, the D-Link DHP-309AV is for people who just want something cheap, easy and discrete. It's not quite as compact as the Edimax Nano, but the adapters are unlikely to crowd out other devices on paired wall sockets.

However, it suffers from the same issues that so many cheap adapters do: it couples 500Mbps powerline with 100Mbps Ethernet. That puts a hard cap on the performance of the device: they may be able to talk to each other at faster than 100Mbps, but they can't talk to your computer at more than 100Mbps, so what's the point then?

You can see that in the test results, where the short range transfers are hard capped by the Ethernet port.

Still, for $60, you can't ask for too much. It still delivered just enough performance at long range for a single moderate bit rate 4K stream.

It may not have the latest tech on offer, but it might just get the job done for you.

Verdict

Best for people looking for a low cost "just works" solution.

★★★☆☆

CRITICAL SPECS: 500Mbps powerline, 100Mbps Ethernet.

$59 | WWW.EDIMAX.COM.AU

Edimax HP-5103K

Teeny, tiny powerline.

The 'Nano' in the HP-5103K's full name is well placed. This adapter pair is one of the smallest you can find, being a square that simply covers its power point but won't crowd out any devices next to it on the wall socket. Given the requirement that powerline adapters be plugged directly into wall sockets, that's nothing to sniff at.

Unfortunately, its speed is an issue. Although it technically supports 500Mbps powerline, it actually bridges to 100Mbps Ethernet, so 100Mbps is the actual cap on speeds. Not that that was an issue at long range: at 25m, it could theoretically stream most 4K video but only one stream at a time, and just barely.

At short range, however, it looks like the Ethernet link might have been the cap on performance.

Verdict

Its performance is a little lame, but at this cost and with the compact design it's worth checking out.

★★★

CRITICAL SPECS: 600Mbps powerline, 1000Mbps Ethernet; power pass-through.

apc HOT PRODUCT

$135 | WWW.NETCOMMWIRELESS.COM

NetComm NP507

All the best stuff.

Although it's soon to be superseded, at the time of writing the NP507 was at the top of the game when it came to powerline specs, with support for 600Mbps and gigabit Ethernet. What's more, it had one touch that just about every user will appreciate: a power pass through, so you don't have to sacrifice a precious wall socket for powerline networking. According to NetCommWireless, that socket also serves as a filter, reducing powerline interference from devices connected to it.

Given it was the only 600Mbps device we tested, its performance didn't stick out from the crowd as much as it might have. But still, it bested the rest, being capable of delivering solid 4K video at even long range. It connected quickly and painlessly, and was even functioning just fine when we pushed it further, to 35m. It's expensive, but a top pick.

Verdict

Pretty great all round (though a little pricey).

★★★★½

CRITICAL SPECS: 500Mbps powerline, 100Mbps Ethernet (two ports in one adapter); 300Mbps 802.11n wireless.

$118 | WWW.TP-LINK.COM.AU

TP-Link TL-WPA4220KIT

A great idea crippled by last-gen tech.

The TL-WPA4220KIT is unique among powerline devices. It serves both as a powerline kit and a Wi-Fi extender or access point. One of the adapters serves double duty as a wireless access point, delivering Wi-Fi access to nearby devices and carrying it back to the main router via powerline. It's a pretty great idea, since this is exactly what powerline is so often used for: to bridge wireless access points without having to resort to wireless range extenders. The Wi-Fi adapter also has a secondary Ethernet port.

The problem is that TP-Link has coupled the adapter with last-gen network tech. Technically it supports 500Mbps powerline, but it can only talk to the router at 100Mbps, which cripples its peak performance. Wireless is limited to 300Mbps 802.11n. If TP-Link could upgrade those to Gigabit and 802.11ac, it would have a pretty great product.

Verdict

A Wi-Fi/powerline combo sounds like a great idea, until you couple it with older tech.

★★★½

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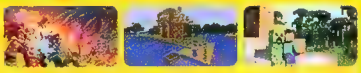

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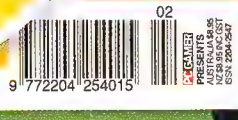

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Mega media storage boxes

Need a centralised spot to store your movies, TV and music? Lindsay Handmer tests four and five-bay NAS boxes, with a particular eye for their media features.

As NAS boxes take on more and more computer like functionality, the software and interface becomes increasingly important. A good NAS OS will constantly receive updates (much like your smartphone), adding in new functionality, fixing bugs and improving performance. For streaming media, it can also bring support for new codecs and playback devices in your network.

Pretty much every NAS on the market can stream media to your DLNA compatible device, such as smart TVs, consoles and media players. A few of the higher end models also include HDMI outputs (plus remote controls) to play media directly on your TV. Even if you already have a media player, this can be a handy way to drive a second TV, or other setup such as a projector.

Some NAS models can also transcode media on the fly. This means that if you have a 1080p file, the resolution can be adjusted to fit devices such as phones and tablets. The advantages are lower bandwidth needed (very important if streaming via 3/4G) and no codec or resolution compatibility issues.

Most NAS devices currently on the market have more than enough grunt to send 1080P footage to a TV. But if you plan on streaming 4K, or want multiple HD streams running at once, a higher end model with more powerful CPU and extra RAM is worth the cost. Some models also allow you to add new features through USB, such as a Digital TV tuner.

Also consider the extra functionality apps provide – especially if you plan to frequently access and manage your NAS from a portable device.

NAS RESULTS

NAS	READ MB/S	WRITE MB/S	CPU	RAM	HDD BAYS	ETHERNET PORTS	USB PORTS	STORAGE SIZE	HDDS	HDD INCL.	EXTRAS
ASUSTOR AS5004T	108.4	109.2	INTEL CELERON 2.41 GHZ DUAL CORE	1GB DDR3	4	2	5	16 TB	2.5", 3.5"	NO	2X ESATA, HDMI
NETGEAR READYNAS	90.41	80.83	MARVELL ARMADA 370 1.2 GHZ	512MB	4	2	3	16 TB	2.5", 3.5"	NO	ESATA
QNAP TS-451 4G	99.26	107.6	INTEL CELERON 2.41 GHZ DUAL CORE	4GB DDR3	4	2	4	24 TB	2.5", 3.5"	NO	HDMI
SYNOLOGY DS415PLAY	106.2	108.4	INTEL ATOM CE5335 1.6 GHZ DUAL CORE	1GB DDR3	4	1	5	32 TB	2.5", 3.5"	NO	
THECUS N5810PRO	105.4	110.9	INTEL CELERON J1900 2.42 GHZ QUAD CORE	4GB DDR3	5	5	5	30 TB	2.5", 3.5"	NO	HDMI
WD MY CLOUD EX4	91.14	90.74	MARVELL 1.6 GHZ	512MB	4	2	2	16 TB	3.5"	UP TO 24 TB	
D-LINK DNS 340L	46.98	79.37	MARVELL ARMADA 370 1.2 GHZ	512MB DDR3	4	2	3	16 TB	3.5"	NO	
SEAGATE 4 BAY NAS PRO	98.95	107.2	INTEL DUAL CORE 1.7 GHZ	2GB DDR3	4	2	3	20 TB	2.5", 3.5"	UP TO 20 TB	
WD MY CLOUD EX4100	106.9	110.8	MARVELL ARMADA 388 2GHZ DUAL CORE	2GB DDR3	4	2	3	24 TB	2.5", 3.5"	UP TO 24TB	
NOONTEC F4 NAS	43.31	69.8	MARVELL 1.6 GHZ	512MB DDR3	4	1	1	16 TB	3.5"	NO	ESATA

CRITICAL SPECS: Bays 4 **CPU** Intel Celeron 2.41 GHz **RAM** 1GB DDR3 **HDD** Up to 24TB **LAN** Dual Gigabit **USB** 5x.

$550 | WWW.ASUSTOR.COM

ASUSTOR AS5004T

A NAS with the media centric features you need.

Powered by a higher end Intel Celeron dual core CPU running at 2.41GHz, the AS5004T has 1GB of DDR3 RAM and four hot swappable HDD bays. If you want more RAM, it's upgradeable to a lofty max of 8GB. The ASUSTOR can handle both 2.5-inch and 3.5-inch drives and has dual Gigabit Ethernet ports with link aggregation and failover support. It also has a massive 5 USB ports - 3 USB 3.0 (one of which supports one touch backup) as well as two USB 2.0 connections. On top of that the ASUSTOR also has dual eSATA ports – overkill yes, but nice to have for connecting up older external drives.

Setup was extremely painless and the NAS was on our network within minutes of dropping in drives. In testing the ASUSTOR actually managed the highest read speed, though was just edged out in write speeds.

The free AiMaster app is one of the better options out there to control your NAS and access files and media on portable devices. Unfortunately though ASUSTOR separates out a whole range of functionality, such as streaming music, into separate apps. While they all work well, having a single solution would be neater.

As expected, the AS5004T handles DLNA media streaming with aplomb. For further integration in your living room, the AS5004T has an HDMI 1.4a output, as well as S/PDIF audio. It's also got an IR receiver, letting you control it directly via the optional remote control.

Verdict

High end features for a surprisingly affordable price tag.

★★★★½

CRITICAL SPECS: Bays 4 **CPU** Marvell Armada 370 1.2 GHz **RAM** 512MB DDR3 **HDD** Up to 16TB **LAN** Dual Gigabit **USB** 3x.

$299 | WWW.DLINK.COM.AU

D-Link Sharecenter DNS 340L

How does a more affordable option perform under pressure?

Under the compact shell, the DNS 340L has a standard Marvell Armada 370 CPU running at 1.2 GHz, backed up by 512MB of RAM. It does have dual Gigabit Ethernet ports though, and three USB connections – but only the front one supports 3.0 speeds. With four top loading bays, the 340L supports up to 16TB of 3.5-inch drives, but there is no 2.5-inch love. You can run the usual RAID configurations – JBOD, 0, 1, 5 and 10.

Unlike our usual D-Link experience, the 340L was a little painful to get running. Frustratingly the web login just wouldn't load until we installed the included software from CD and ran the finder. While fiddly at first, once we were up and running, the interface was generally pretty good.

The D-Link NAS supports DLNA and iTunes media streaming, as well as automatic backups.

The mydlink Access app is quite good, and covers the basics such as NAS management and remote file access. You can also access your data directly through the web interface. The D-Link can handle your file serving, torrent downloading and IP surveillance cam recording needs. In our testing the fan never even spooled up, so the NAS was totally silent.

Thanks to the lower end CPU and lesser RAM, the D-Link is one of the slower devices we tested. Of course it's also one of the cheapest, so offers decent bang for buck and realistically is fast enough for any normal media streaming you might want to do.

Verdict

A cheap but cheerful option for the less demanding user.

★★★½☆

CRITICAL SPECS: Bays 4 **CPU** Armada 370 1.2 GHz **RAM** 512MB DDR3 **HDD** Up to 16TB **LAN** 2x Gigabit **USB** 3x.

$250 | WWW.NETGEAR.COM

Netgear ReadyNAS RN10400

Can a more affordable NAS keep up?

Shipping diskless, the RN10400 can handle 3.5-inch or 2.5-inch drives in the hot swappable bays, for a total capacity up to 16TB. Inside it runs a Marvell Armada 370 1.2GHz CPU matched up with 512MB of RAM. While the data speeds were not top shelf, it's important to remember that the ReadyNAS is the most affordable 4 bay options we tested.

Setup is easy enough (though only 3.5-inch drives are tool-less) and the management software is straightforward to use. The ReadyNAS was a little reluctant to get itself onto our network at first, but showed up with minor fiddling.

The RN10400 has the typical dual Gigabit Ethernet ports, as well as two USB 3.0 ports, and a USB 2.0 connection that supports one touch backup. You also get an eSATA port, which can be handy for connecting any older external drives kicking about. The free mobile app is reasonable and gives fairly comprehensive access to your files and media when on the go.

The ReadyNAS has a big honking steel carry handle around the back, which makes it really easy to carry if you plan on moving the unit around a lot.

The RN10400 can run the Plex media server, which gives a bit more flexibility for streaming. It can also handle iTunes and DLNA. You can also run automatic backups with the Windows app, or Time Machine for iOS. The NAS also supports the usual Bittorrent downloads, IP camera recording and hosting software such as WordPress.

Verdict

Excellent bang for buck considering the bargain price.

★★★★☆

CRITICAL SPECS: Bays 4 **CPU** Marvell 1.6 GHz **RAM** 512MB DDR3 **HDD** Up to 16TB **LAN** Single Gigabit **USB** 1x.

$369 | WWW.NOONTEC.COM.AU

Noontec F4NAS

A stylish chunk of aluminium with a small footprint.

An unfamiliar name to many, the F4NAS squeezes decent specs into a very compact little device. It uses a common Marvell 1.6GHz CPU, 1GB of RAM and has four 3.5-inch drive bays. You can install a total of 16TB in RAID 0/1/5/6/10/JBOD, but no adaptor is included for 2.5-inch drives. It's worth noting that the aluminium drive bay holders look and feel great, but can be a little stiff and notchy to install.

The F4NAS only has a single Gigabit Ethernet port, but it is complemented by eSATA. Disappointingly there is only a single USB connection, and worse, it's only 2.0 speed.

Getting the NAS onto the network was easy enough using the Noontec software and while the layout is a little clunky, it gets the job done.

There is supposed to be an app for Android and iOS, but we couldn't actually find it online. It is possible to access the NAS remotely through a web browser though.

Access speeds are reasonable, but outclassed by the cheaper competition.

The F4NAS supports the usual print and FTP server and can handle torrent downloads. It's ready for streaming too, with DLNA support. External storage can be added via eSATA or USB. T

In normal operation the NAS is fairly quiet thanks to a single large rear fan, but gets a little noisier under load. If you happen to move your NAS around a lot, the F4NAS has a very useful handle on top.

Verdict

Considering the price, the F4NAS lacks some core functionality such as USB 3.0.

★★★☆☆

CRITICAL SPECS: Bays 4 **CPU** Celeron 2.41GHz **RAM** 4GB DDR3 **HDD** Up to 24TB **LAN** Dual Gigabit **USB** 2x 2.0, 2x 3.0.

$720 | WWW.QNAP.COM

QNAP TS-451 4G

Is it worth paying extra for performance?

Powered by a 2.41GHz Celeron CPU, the TS-451 also has a massive 4GB of RAM that is further upgradable to 8GB. You get dual USB 3.0 (one front, one back), two USB 2.0 ports and dual Gigabit Ethernet. The four drives bays easily slot in and out and can handle both 2.5-inch and 3.5-inch HDDs. Setup was fast and painless, and the management interface is well laid out with good access to core functionality.

The TS-451 has a large rear mounted fan, but was virtually silent in operation. Access speeds are excellent and the NAS has full backup functionality. The QNAP apps give simple Dropbox like file syncing between devices. The TS-451 will also function as a file downloader, printer server and can connect to Wi-Fi or record digital TV via a USB device.

For those after extra security, the NAS supports AES-256 bit volume encryption and supports IP camera recording.

The TS-451 is DLNA ready, but also has an HDMI port and can play back 1080P with 7.1 surround sound. If you stream media to a lot of different devices, the TS-451 can also handle on the fly transcoding. This is handy for playing back video on portable devices and lets you minimise bandwidth use and avoid issues with codec compatibility. You can also set the NAS to transcode 4K media, though not on the fly. The QNAP lets you use your mobile as a remote, but also has an optional IR controller.

Verdict

Pricey, but with great features and performance.

★★★★

CRITICAL SPECS: Bays 4 **CPU** Intel 1.7 GHz **RAM** 2GB DDR3 **HDD** Up to 30TB **LAN** Dual Gigabit **USB** 3x.

$800 | WWW.SEAGATE.COM

Seagate 4 Bay NAS Pro

Are the features worth the extra price?

Aimed at higher end users, the 4 Bay NAS Pro has an Intel Dual Core CPU running at 1.7GHz, as well as a large 2GB of DDR3 RAM. It has dual Gigabit Ethernet ports (that support failover and link aggregation), as well as two USB 3.0 (with one touch backup) and one USB 2.0 connection.

You can get the Seagate as a diskless NAS, or equipped with up to 30TB across four drives. The bays are hot swappable and support both 2.5-inch and 3.5-inch drives. It also supports the usual array of RAID options – JBOD, 0, 1, 5, 6 and 10.

The NAS Pro was really simple to set up, and was one of the quickest NAS boxes to get onto the network. We got a very slightly slower read speed than expected, but overall the read and writes are excellent.

The Seagate NAS OS 4 is very easy to use, and the extra S drive software is one of the better ways of sharing files between your NAS, desktop and mobile devices. The NAS Pro is ready for your media as well, and supports UPnP and DLNA media streaming, as well as an iTunes server.

To stop people walking off with your data, it has a Kensington lock port and supports 256 bit AES encryption. You can also view and record IP security cameras and schedule backups.

Thanks to a large, slow spinning fan, the Seagate NAS is fairly quiet, even under load.

Verdict

Well equipped, but doesn't offer stand out value.

★★★½

CRITICAL SPECS: Bays 4 **CPU** Intel Atom Dual Core 1.6GHz **RAM** 1GB DDR3 **HDD** Up to 32TB **LAN** Single Gigabit **USB** 5x.

$605 | WWW.SYNOLOGY.COM

Synology DS415play

Media lovers rejoice!

Unlike other NAS devices that try to please everyone, the DS415play is totally aimed at those who want to stream content. A larger 4 bay version of the excellent DS214play, the Synology NAS can store up to a massive 32TB of media collection. Inside is a Dual Core Intel Atom CE5335 CPU that buzzes along at 1.6GHz, as well as 1GB of DDR3 RAM.

The Synology NAS feels a little plasticy at first, but once you get the slightly bendy tool-less drive bays locked away, the overall build quality is quite good. The front has a single USB 2.0 port, while you get another two round the back, as well as dual USB 3.0 connections. Unlike some of the competition, it only has a single LAN port, but for typical use this is no real loss.

The DS415play also has an array of solid Synology apps to make it easy to access your media on portable devices.

Importantly, the Synology NAS can transcode 1080p video on the fly. Not just to one device either – separate users can be transcoding media at the same time. This is particularly handy if you like to stream content to a range of portable devices but don't want to mess around with codec support, or need to use wireless bandwidth efficiently. Whether or not it's a feature needed for your media setup, it would have been nice to see an HDMI port on the DS415play for direct playback.

Verdict

Strong performance and functionality without going over the top in price.

★★★★☆

CRITICAL SPECS: Bays 5 **CPU** Intel Celeron J1900 2.42GHz **RAM** 4GB DDR3 **HDD** Up to 30TB **LAN** 5x Gigabit **USB** 5x.

$1,200 | WWW.THECUS.COM

Thecus N5810PRO

High-end features for a price.

Powered by an Intel Celeron J1900 CPU at 2.42GHz and featuring a massive 4GB of RAM (expandable to 8GB), the Thecus N5810PRO pushes the boundaries of performance. It can handle both 2.4- and 3.5-inch drives across 5 lockable bays. If that wasn't enough, it's also got 5 Gigabit LAN ports, which all include link aggregation and up to 500MB/s speeds. You also get 5 USB ports (3x USB 3.0) for extra connectivity.

Setup was as simple as installing drives and firing it up. The Thecus OS5 operating system has excellent depth of control, whilst remaining intuitive to navigate. You can also control some functionality via the front face buttons and LCD panel.

The N5810PRO includes a built in mini UPS that gives the system time to write any data and shut down safely in the event of a power outage. It also moves the PSU inside the NAS, getting rid of the power brick completely.

The N5810PRO has an HDMI output for directly playing back media, plus a 3.5mm audio line out jack. It also supports the usual DLNA media streaming, as well as the TV on the Go content platform. The NAS also handles the usual array of backups, IP camera recording, virus checking and encryption.

While the most expensive NAS in our roundup, the Thecus also has the fastest write speed, albeit by a very very small margin. It's also got the most features, though unless you plan on using them, it's possibly overkill for home use.

Verdict

Despite features not found anywhere else, it's still an expensive option.

★★★★☆

CRITICAL SPECS: Bays 4 **CPU** Marvell 2GHz **RAM** 512MB DDR3 **HDD** Up to 16TB **LAN** Dual Gigabit **USB** 3x.

$500 | WWW.WDC.COM

WD My Cloud EX4 Personal

Positioned above the budget options, but not yet high-end.

Rather than going all out like the more expensive EX4100 Expert, the Personal WD NAS has pretty modest specs. Powered by a 2.GHz Marvell CPU and only 512MB of RAM, the efficient WD OS means the EX4 still gets quite good read and write speeds.

The EX4 has 4 hot swappable, tool and tray-less bays that support 3.5-inch drives in RAID 0, 1, 5, 10 and JBOD. While you can get it as a diskless model, the EX4 is also available ready to go in sizes up to 16GB.

Round the back the EX4 sports dual gigabit Ethernet ports (with link aggregation and failover support), as well as two USB 3.0 connections. You even get a double up on power inputs for extra redundancy. The NAS can be set to handle HTTP, FTP and P2P downloads, perform automatic backups and sync data with your existing cloud storage. You can also encrypt the drives, run a print server or record from IP security cameras.

The free WD My Cloud mobile app is excellent and makes it simple to stream media, access files and control NAS settings. There is also a desktop app, which gives better functionality than just a web interface. You can stream media to the usual DLNA and iTunes compatible devices. You can also run other apps, such as WordPress or SqueezeCenter.

Sure, the EX4 is not the fastest, or quite the cheapest NAS. But considering the excellent apps and features, it does offer some very compelling bang for buck.

Verdict

A great budget option with some of the best apps available.

★★★★☆

CRITICAL SPECS: Bays 4 **CPU** Armada 388 2GHz **RAM** 2GB DDR3 **HDD** Up to 24TB **LAN** Dual Gigabit **USB** 3x USB 3.0.

$699 | WWW.WDC.COM

WD My Cloud EX4100

A higher-end NAS aimed at those who need the best.

A step above the EX4 Personal NAS, the 4100 knocks thing up a notch. It's powered by the excellent Marvell Armada 388 CPU, which has dual cores and runs at 1.6GHz. It's also got 2GB of RAM and comes in a diskless, or ready populated model up to 24TB.

Setup is as simple as running the web based interface and selecting a few options. It's well laid out and easy to delve into some of the deeper functionality without a guide. The drives are hot swappable to make it easy to add or remove storage. The WD apps are excellent, and ensure reliable access to your content from portable devices. As expected, the EX4100 can also stream media to DLNA compatible devices. The NAS will also run programs such as WordPress and phpBB.

The WD promises up to 116MB/s read and write, and the real world figures don't fall much below that. It's not a huge jump over the EX4 personal (considering the price), but if you demand the very fastest speeds then it could be worth the extra cash. The NAS also has features such as dual power inputs for reliability. The WD supports AES-256 bit encryption for security and handles automatic backups, but doesn't have a built in virus checker. You can run the usual FTP file and print servers, download via P2P or set up a JBOD/0/1/5/10 RAID array. Under load the EX4100 can be a little noisy, and when full of drives significant mechanical noise escapes.

Verdict

Strong performance, but a big price bump over the personal edition.

★★★½☆

how to

» QUICK TIPS

Experts solve your computing problems

APC and its readers can be one giant helpdesk. If you have a technical problem, chances are one of us can solve it

Recycling the hard disks from old PCs or Macs is rarely worth the trouble.

Third-party codec packs can sometimes cause trouble with audio, but it's odd for games to.

HARDWARE

RE-USING LEFTOVER MAC HARD DRIVES

I have two Mac Pros (the tower case kind). One is getting rather old and will soon be replaced, but the hard disks in it are quite large (500GB and 1TB) and I am thinking of fitting them in the other, which has its own 1TB drive. What is the best way to set these up?

Keith Morten

Are you actually short of disk space, or just giving the old drives a good home? If it's the latter, I would counsel against it. This just creates more points of failure and makes your backup strategy more complicated. The simplest system is to have one drive for everything and another drive of at least the same size (ideally a bit bigger) for Time Machine. If you don't already have a Time Machine drive then I'd use the 1TB drive for this and dump the 500GB. If the Mac Pro you use is already adequately backed up and you don't urgently need more disk space, then I wouldn't bother at all.

If you are short of disk space, then you could install the 500GB drive for your data and use the other 1TB disk as its Time Machine backup. This will allow you to keep lots of backups of the data files.

I'd still favour replacing your existing disk with one large enough to hold both apps and data (and another to back that up) rather than reusing old drives. Hard drives older than five years have a much higher failure rate so it is rarely worth reusing them, unless your budget is very tight.

Louis Villazon

Network monitoring app Glasswire spots itself when it checks which programs are accessing the internet.

SECURITY

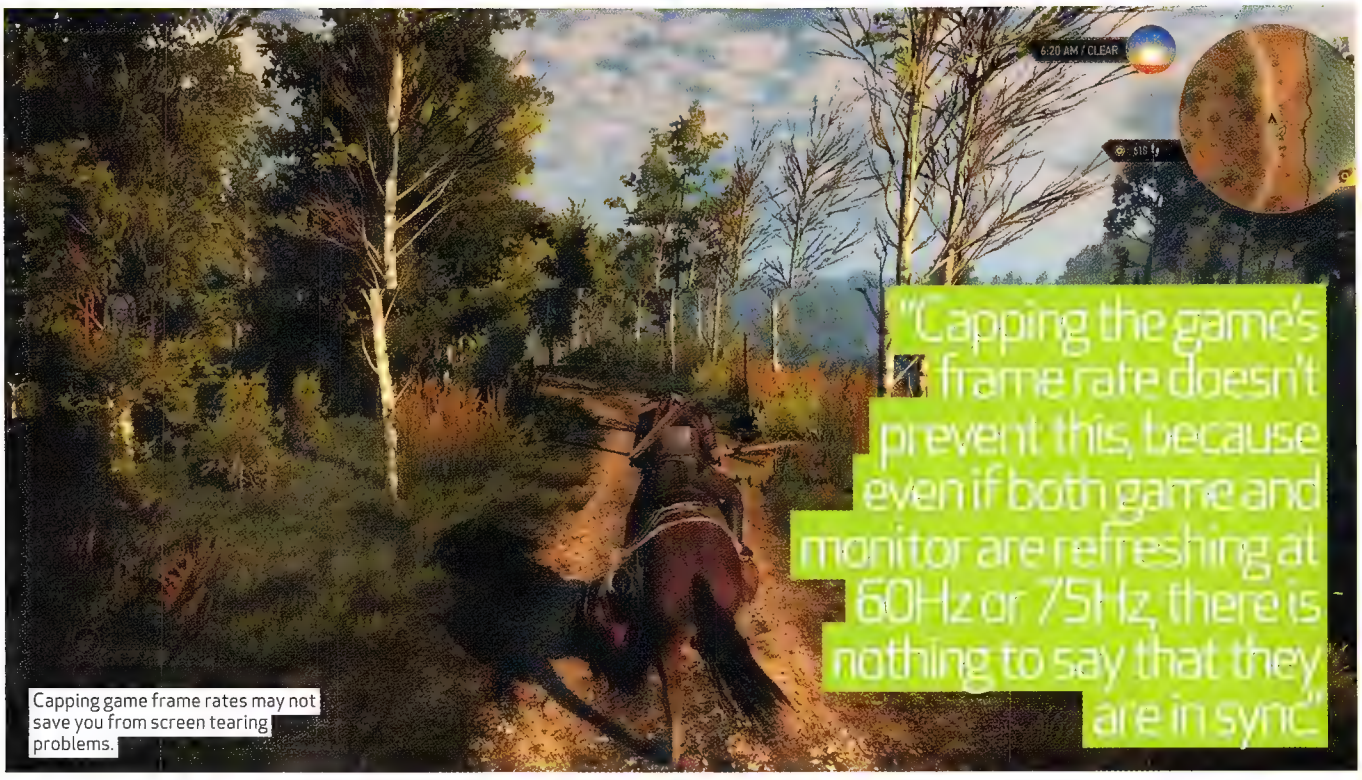
SUSPICIOUS EXE

I'm hoping you will be able set my mind at ease about a security problem I'm having. I recently downloaded an app called Glasswire to see which programs on my PC are accessing the internet. It lists something called gwinstst.exe but this doesn't show up on Task Manager, which makes me suspicious. It's installed in appdata\local\temp, which seems suspicious as well.

Tim Mumford

Installing one of these monitoring apps is sort of like owning a gun. Statistically speaking, having a gun makes you more likely to be shot, and yet people buy guns to protect themselves. Similarly, downloading lots of monitoring apps because you are paranoid about being hacked normally just makes you feel even more paranoid. That exe is part of Glasswire itself, so it's probably quite safe. We say 'probably' because there is always the possibility that Glasswire is doing some nefarious scanning or downloading in the background.

Luis Villazon



Capping game frame rates may not save you from screen tearing problems.

WINDOWS

PUMPKIN O'CLOCK

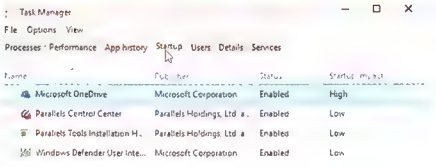
My desktop PC switches to the desktop at exactly midnight every day. Whatever I am playing at the time makes no difference. Midnight chimes and I drop back to the desktop. The original program is still running, so I can Alt-Tab to get back, but it's annoying just the same. I have had this PC for many years, upgrading piece-by-piece along the way, and it has always done it. I thought (or at least hoped) that upgrading to Windows 8 would fix it, but no such luck.
Aiden Kieley

Sounds to me as if you have something set to launch at midnight and this is stealing focus from your full-screen app, which causes you to flip to the desktop. Try booting into Safe Mode at 11:55pm and see if it stops happening. Or better yet, open Task Manager just before midnight and see what new application or process loads at the hour. If you click the Startup tab in Task Manager, you should be able to locate that app and disable it. If it doesn't appear there, try searching the registry for the name of the app or process. Some applications have update checkers that load at specified times.
Louis Villazon

HARDWARE

DON'T HARSH MY BUZZ

I'm experiencing a very weird glitch. I have an external sound card (an ASUS Xonar DX) with a gaming headset plugged into it. I recently installed the Shark 007 codec pack along with some other stuff and since then I have had a strange buzzing sound coming through the headphones. I know the problem isn't with the headset because if I disable system sounds in the volume mixer, the buzz goes away. But the only other thing it could logically be is the Shark 007 codec



Check the Startup tab in Task Manager to stop troublesome apps automatically loading.

and I have uninstalled that, to no effect. Could the codec have corrupted my sound card settings somehow?
Lee Angel

We did a little digging and it seems this isn't caused by the Shark 007 codec, it's caused by *Oblivion*. Yes, *Oblivion*, the *Elder Scrolls* game. There used to be a very obscure bug in *Oblivion* that corrupted the surround sound settings on some soundcards. This must have got written to a configuration file somewhere, because the buzzing sound it created would persist through a reboot but only manifested itself in 7.1 surround sound. If you press the 7.1 button on your Xonar to disable surround sound, and then press it back again, you'll find the buzz disappears.
Luis Villazon

HARDWARE

TERRIBLE TEARING

I'm getting a lot of screen tearing in games, even though I have my fps capped to the monitor refresh rate. I thought the whole point of capping my fps was to prevent tearing? I have reinstalled a couple of games to see if it made any difference (and my graphics drivers are up to date) but it's still doing it. Would upgrading to Windows 8 or a faster graphics card help?
Rav Sandhu

No and no. We suspect you've misunderstood what causes screen tearing. Your graphics card has a frame buffer that holds the current frame as it is rendered and the monitor has a refresh rate that determines how often it copies the contents of that buffer to the screen. But that buffer takes a finite amount of time to fill and if the monitor happens to grab the buffer while it is still being filled, it will take part of the current frame and part of the frame before. Unless the scene is perfectly still, the two halves won't match up and you'll see the join. This is known as tearing. Capping the game's frame rate doesn't prevent this, because even if both game and monitor are refreshing at 60Hz or 75Hz, there is nothing to say that they are in sync. If the game is updating just a fraction before the monitor, you'll still see a torn frame. Running at the same refresh rate actually makes things worse, because every frame will be torn.

What you need to do is enable vertical sync, either in the game or in your graphics card driver options. This forces the graphics card to wait for the monitor to grab a frame before it starts writing to the frame buffer with the next one. The frame rate is still capped to the monitor refresh rate, but it is also synchronised with it.

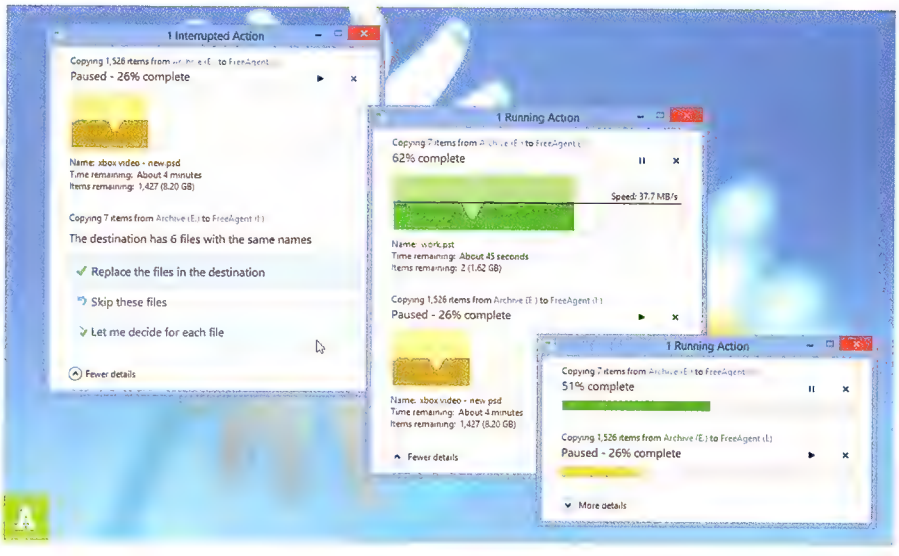
Vertical sync can arguably be a bad thing in online games because the netcode is often updated at the same time as the frame. Restricting the frame rate means that you send fewer position updates to the server, which makes things a bit more laggy. This is apparently significant enough for 'serious' players to prefer playing with v-sync off, but in single-player games you won't notice or care.
Luis Villazon

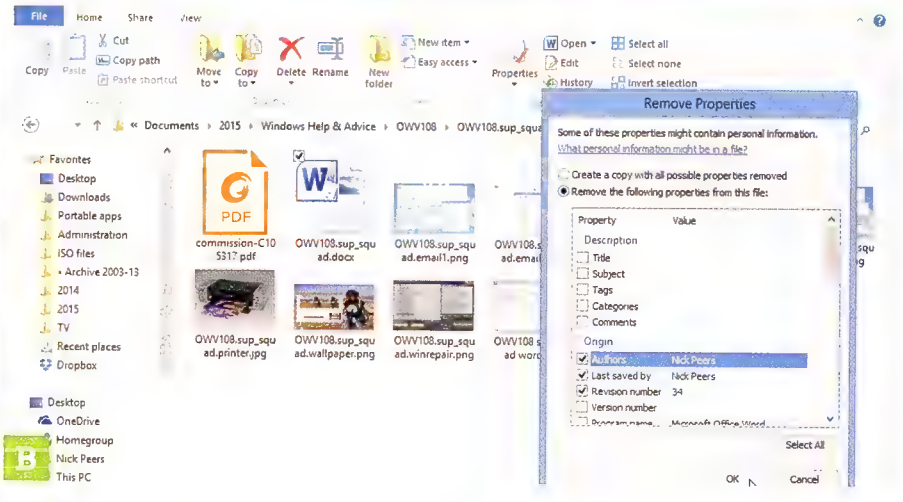
Take control of Windows 8.1's File Explorer

Windows 8.1's File Explorer is more than just a rebadged version of Windows Explorer. Nick Peers shows you how to get the best from it.

It's a revelation. Thanks to a raft of improvements and new features, Window's 8.1 File Explorer makes managing your files easier than ever. There's the improved file copying tool, which not only speeds up file transfers, but makes them easier to manage, too. The new ribbon-based UI places all the key tools you need within easy reach, and the Navigation pane remains a great way to quickly move to the different parts of your PC.

In this tutorial, we'll reveal File Explorer's best features, some of which are hidden away from view. We'll also show you how to make File Explorer even more useful by customising it to your personal requirements. You'll be working smarter before you know it!





1 CUSTOMISE NAVIGATION PANE

Click the 'File Explorer' button on the Taskbar to open a File Explorer window. The Navigation pane on the left is designed to put frequently accessed folders and drives at your fingertips. Click Navigation on the View tab to show or hide the Favourites list, plus restore the Libraries view. Choose 'Show all folders' to unite all other lists under a single Desktop view.

2 QUICK-FIRE SELECTIONS

When the 'Item check boxes' box is ticked on the View tab, selecting a file or folder results in a box being ticked. You can choose one of two ways: roll the mouse over an item and then click the tick box that appears, or use the old Ctrl-click method to quickly choose a host of files. Either way, it's a more elegant way of making multiple selections.

3 QUICKLY MOVE AND COPY FILES

You can, if you prefer, open two File Explorer windows (select 'Open new window' on the File tab) for moving or copying files, but why not try this shortcut? Navigate to the Home tab where you'll find two buttons: 'Move to' and 'Copy to'. Click either button to access a list of frequently used locations, or browse for a specific folder.

4 FASTER, IMPROVED COPYING

When files are being moved or copied, a new dialog provides more options, particularly when you may need to replace (or ignore) existing files. During the copy process, click the expand button to see the file transfer speeds. The new dialog also allows you to pause and resume transfers – handy when you want to suspend a large transfer temporarily. [Image A]

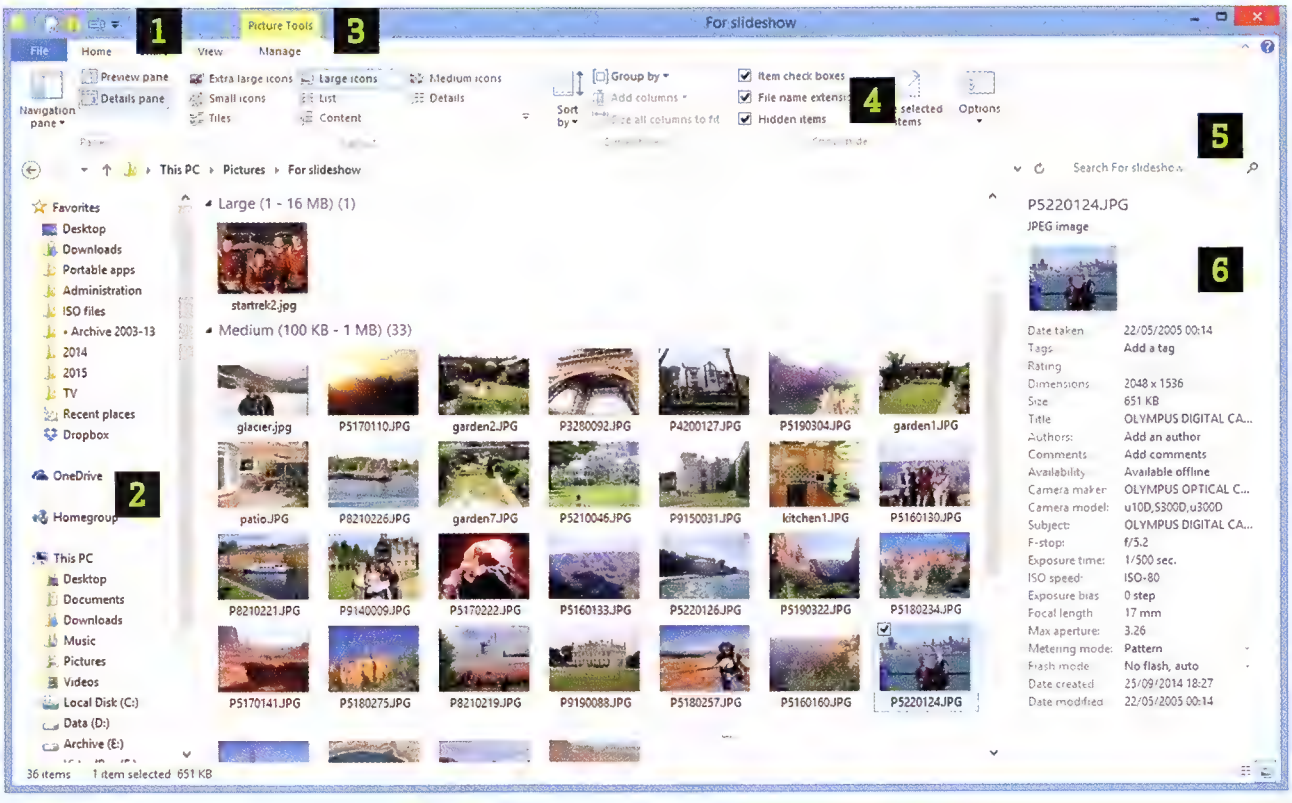
5 EDIT FILE PROPERTIES

Want to share a file without including all that private metadata such as its author? Select the file, then click the arrow beneath the Properties button on the Home tab and choose 'Remove properties'. You can create a separate copy stripped of personal information, or select which properties to remove from the file itself – click OK when done. [Image B]

6 ROLL BACK FILES

Need access to an older version of a file? Select the file or folder in question, then click the History button on the Home tab. Right-click the file and choose Preview, then use the playback controls at the bottom to locate the version you want to restore. Click the Restore button to overwrite the original file, or click 'Settings ›

Under new management



1 QUICK ACCESS TOOLBAR
Add any File Explorer button you like here for quick and easy access — up to six options are provided by default.

2 NAVIGATION PANE
Use the Home tab's Easy access button to add your most-used folders to the Favourites section for speedy access.

3 CONTEXT-SENSITIVE TABS
These tabs appear when certain items are present — click a file or folder to access context-sensitive controls.

4 VIEW TAB
Use the View tab to set up how the current folder looks and behaves — changes will only apply to this folder.

5 SEARCH
Type search terms here to look through the current folder — use the ribbon's Search tab to fine-tune the results.

6 DETAILS PANE
Selecting this and clicking a file or folder reveals its details without having to manually open its Properties box.

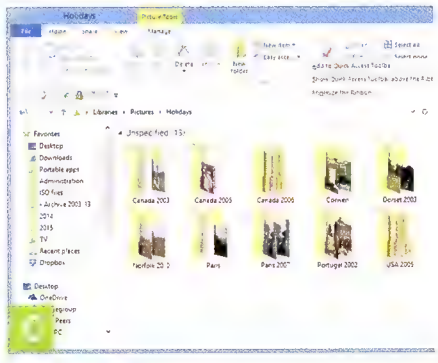
Restore to' which will save a separate copy instead.

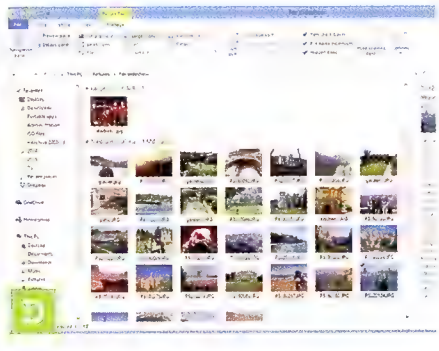
7 CUSTOMISE SEARCHES
Enter your search terms into the Search box and hit Enter — a new Search Tools tab will appear. Use this to change the location of the search, plus refine the search terms using filters such as type of file, size and when it was last modified. You can also access recent searches, change which folders are indexed via the 'Advanced options' button, and save your search.

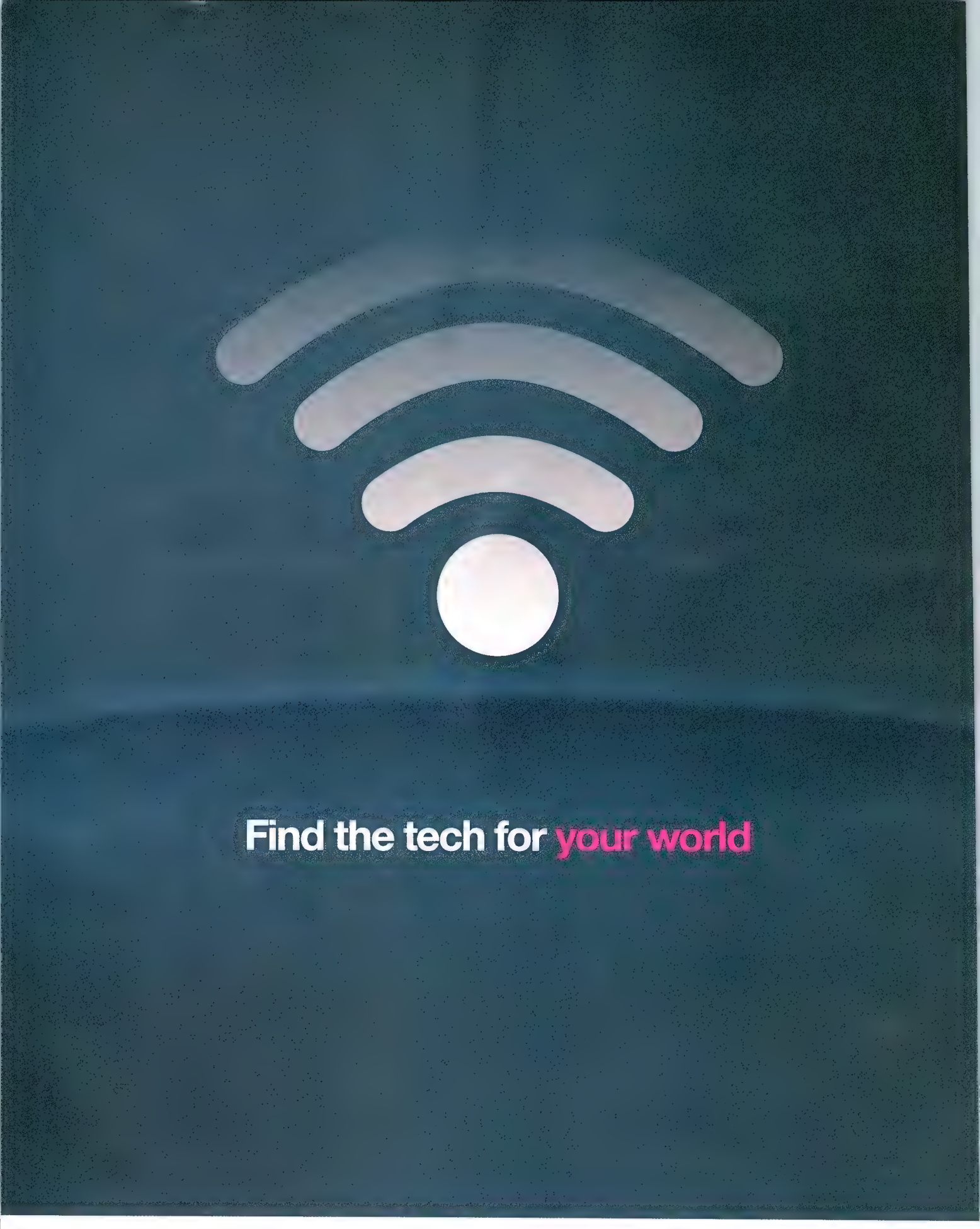
8 SHARING OPTIONS
The Share tab contains more than just the usual options. This is where you go when you want to burn selected files to disc, print or fax them, add them as an attachment to an email, or compress them into a .zip file. An 'Advanced security' button is also here if you need to fine-tune access permissions.

9 QUICK ACCESS TOOLBAR
You can add any File Explorer item you'd like to the Quick Access Toolbar by right-clicking its button and then choosing 'Add to Quick Access Toolbar'. [Image C] There's space to display up to seven items above the ribbon on the Toolbar. Alternatively, you can click the Customise button and choose 'Show below the ribbon' to give it some more room. Manage the Toolbar by right-clicking unwanted items and choosing the Remove option.

10 HIDE THE RIBBON
The ribbon user interface at the top displays a series of toolbars in separate tabs, instead of a more traditional menu-based system. If it's not to your taste, click the '^' button in the top right-hand corner. That hides everything except the tabs and the Quick Access Toolbar. Click a heading to view the options for that tab — when you click away from the ribbon it'll disappear. [Image D]







techradar.

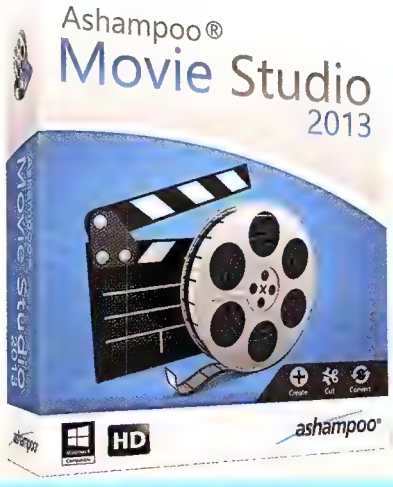
disc contents

» OUR SELECTION OF EXCLUSIVE FULL-VERSION PROGRAMS

ISSUE 417 JULY 2015

NO DISC FOR NEW ZEALAND READERS?

Due to a New Zealand legal requirement that all physically-distributed video games (including indie titles and demos) must be rated by the Classification board, we're sadly no longer able to offer our cover disc in New Zealand. However, so our loyal NZ readers don't miss out, we've created a special download page where you can access the exclusive software each month. You'll find it at **www.apcmag.com/exclusives**. While we've created this download page for New Zealand readers, it's also open to all of our Australian and tablet-edition readers too. All you need are the links and zip passwords printed below to be able to download and extract these exclusive full-version apps.



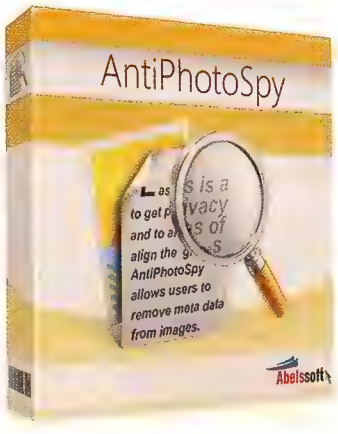
Create beautifully cut films

Become a directorial pro with Ashampoo Movie Studio 2013

FULL VERSION WORTH $49.95

Ashampoo Movie Studio 2013 includes everything you need to edit and produce your home movies from start to finish in a step-by-step fashion. You can cut, trim and convert videos, add background music, apply transition effects and text overlays and then export to file or burn to disc, all in one handy package.

NZ DOWNLOAD LINK: WWW.ASHAMPOO.COM/LPA/APC



Clean your photo metadata

Share an image without the personal details with Abelssoft AntiPhotoSpy 3

FULL VERSION WORTH $15

With AntiPhotoSpy 3 you can easily search your computer for batches of photos and graphics using meta data and then remove any sensitive data all at once. You can also simply store all of your files without metadata in a separate folder.

NZ DOWNLOAD ZIP PASSWORD: July15a

Search your drive in seconds

Do away with slow Windows searches with 1.abc.net File Finder 7

FULL VERSION WORTH $15

1-abc.net File Finder 7 is a solution for Window's clumsy search functionality. Select one or more paths (or even a complete drive if you wish), configure how the searching process will behave and get a list of all the files you're after. You can then save the results list as a *.txt file or your own personal searching options to find your data even faster.

NZ DOWNLOAD ZIP PASSWORD: July15a

PLUS!

SYSTEM REQUIREMENTS

- A DVD-ROM reader or burner.
- The *APC* disc is designed for use with up-to-date browsers (for example, Internet Explorer, Chrome, Firefox).
- The interface included on the *APC* disc requires a JavaScript-enabled browser.
- An internet connection may be required for online registration of software before use.
- The software packages on the *APC* disc have different system requirements. Software is included on the disc for Windows Vista, 7 and 8.

BEFORE INSTALLING

- Check the disc using a virus scanner complete with the latest antivirus data updates. The disc was checked before burning, but new viruses are being discovered all the time.
- Back up any important system and data files. It is not recommended that the software contained on these discs be installed on production machines.
- If you have any questions regarding the use of the *APC* disc, click the 'Help' button at the top of the screen.

USING THE DISC

- Insert the disc into a CD/DVD-ROM reader or burner and your web browser should automatically load the interface. If not, launch your web browser and load the default.html file from the root directory of the disc.

HELP

- If you have any problems with the *APC* disc, please visit **www.apcmag.com/disc.htm**.
- *APC* provides no technical support for this disc or any software provided on it.

NO DISC?

Please note the free disc is not included with NZ copies, digital editions or bundled promotional copies of *APC*.

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Setting keyboard shortcuts in macros

This month, Helen Bradley explains how to define keyboard shortcuts inside an Excel macro

Excel VBA contains a handy method so you can create keyboard shortcuts in VBA code. This month we'll look at a routine that uses this method.

THE SCENARIO

Our scenario will solve the problem of needing to insert rows into a worksheet in an ad hoc manner. If you do this a lot it would be useful if the Insert key were to perform the task for you. We'll create a set of macros to do this. One macro will insert the row and another will use the OnKey method to remap the Insert key to run this macro. For completeness we'll also create a macro to return the Insert key to its default behaviour.

Another possible application for the OnKey method is to disable a key so it does nothing. Our macro includes code that disables the Left Arrow key so you can see how that would work.

THE CODE

This is the code to type in a new module in the workbook you can download from **www.apcmag.com/magstuff**:

```
Sub setMyShortcut()
With Application
    .OnKey Key:="{insert}",
procedure:="InsertTableRow"
    .OnKey Key:="{left}",
procedure:=""
End With
End Sub


Sub InsertTableRow()
 Selection.EntireRow.Insert
End Sub

Sub resetMyShortcut()
With Application
    .OnKey Key:="{insert}"
    .OnKey Key:="{left}"
End With
End Sub
```

The OnKey method takes the code of the key to remap and a procedure to run when you press that key. The procedure name is placed inside double quotation marks. If no procedure is included then the key is returned to its original state. If the procedure name is an empty string then that key is disabled. To test this, you must first run the macro setMyShortcut and then the Insert key will run the InsertTableRow macro and the Left Arrow key will do nothing.

To undo the assignment and return the keys to their default behaviour, run the macro resetMyShortcut.

AUTOMATING THE SOLUTION

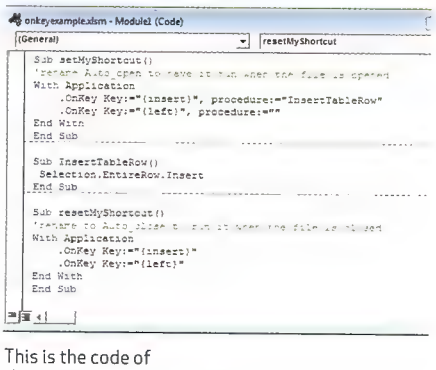
You can further automate this solution by running the macro setMyShortcut whenever the Excel workbook is opened and running the macro resetMyShortcut when the worksheet is closed. You can do this using specially named macros – Auto_Open and Auto_Close which, if they exist, are run automatically by Excel.

It is good practice to create your macros and test them using another name. Only when you are sure they behave as expected should you rename them.

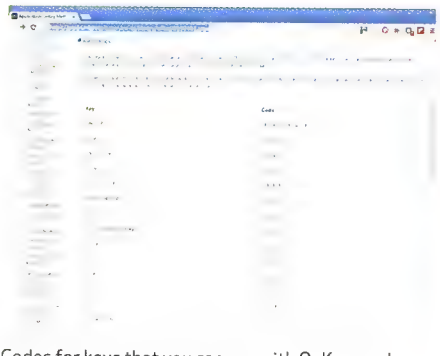
KEY CODES TO USE WITH ONKEY

You can use a range of codes with the OnKey Method. Use % for Alt, ^ (carat) for Control and + (plus) for Shift. Any keyboard letter can be used in combination with these modifier keys so, to assign a macro to the keyboard shortcut Control-Alt-B, you would use "%^B" with the OnKey method. ■

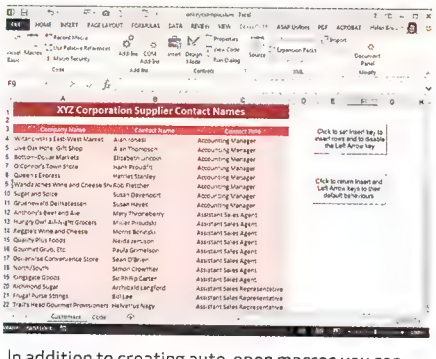
> "Our scenario will solve the problem of needing to insert rows into a worksheet in an ad hoc manner."



This is the code of the macros.



Codes for keys that you can use with OnKey can be found here: **tinyurl.com/qfwq9pp.**



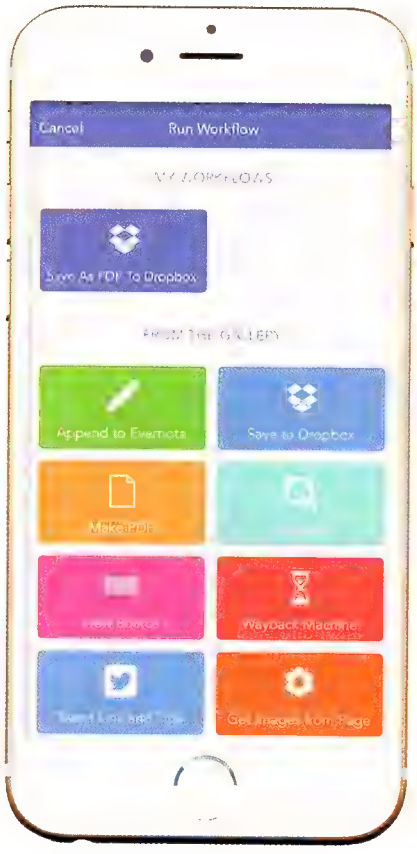
In addition to creating auto-open macros you can also allow the user to set the shortcut keys by pressing a button on the worksheet, as shown here.

THE
MOST FUN
YOU CAN
HAVE WITH
YOUR HANDS
WITHOUT
C C I N E

games radar
MORE KICKS PER CLICK

Automate iOS tasks with Workflow

Create your own workflows on the iPhone (or an iPad) with Lucy Hattersley.



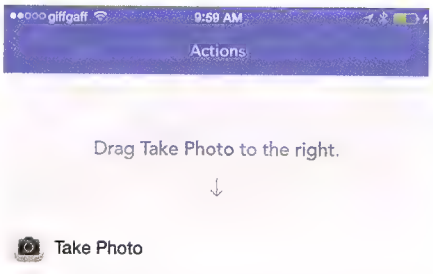
The more you use iOS 8 and an iPhone, the more you realise how, really, you've got a personal computer in your pocket. The only thing missing from iOS has been programming and automation – until now. Workflow ($3.99) fixes that by bringing a Mac-like Automator tool to the iOS platform.

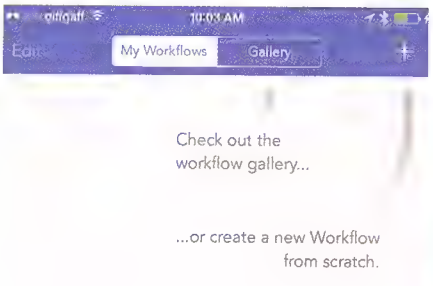
Workflow integrates with other apps such as Calendar, Contacts, Music, Photos and Videos, and can create PDF documents, share items on social media, save files to Dropbox and a huge range of other tasks. These workflows can be run from within the Workflow app, or turned into extensions and accessed through the Run Workflow option in the Share menu. Workflow is so versatile, you may be at a loss with what to do at first, but there are many examples to help you get started.

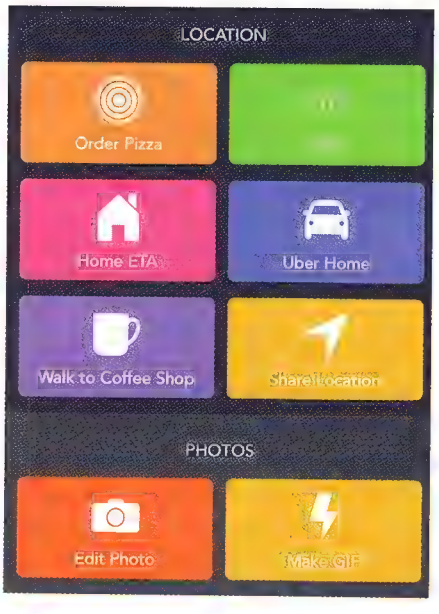
Here we're going to show you how to browse actions and turn them into a workflow. We'll then look at finding examples from the Gallery before creating an extension that turns web pages into PDFs and saves them to Dropbox. We'll then submit this workflow to the Gallery for other users to find.

Go with the flow

Create and share your own workflows.







1 RUN THROUGH THE INTRO

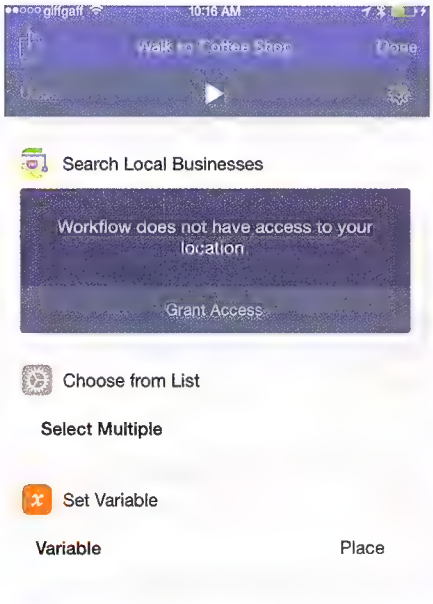
Open Workflow and it walks you through a demonstration. Drag the 'Take Photo' icon bar to the right, drag 'Make Gif' to the right (drop it below Take Photo), drag 'Quick Look' to the bottom of the items and choose from Post on Facebook, Send Email, Send Message or Tweet. This is how you create workflows; tap the Play button at the top. Tap Done when finished.

2 MY WORKFLOWS

You now see a blank screen ready for your own creations. At the top are four icons: Edit, My Workflows, Gallery and Add (+). There are two ways to add new workflows: use the Gallery to access others' workflows, or tap Add and create your own. The Edit button is used to re-arrange and remove workflows (but not rename them, you do that from Settings).

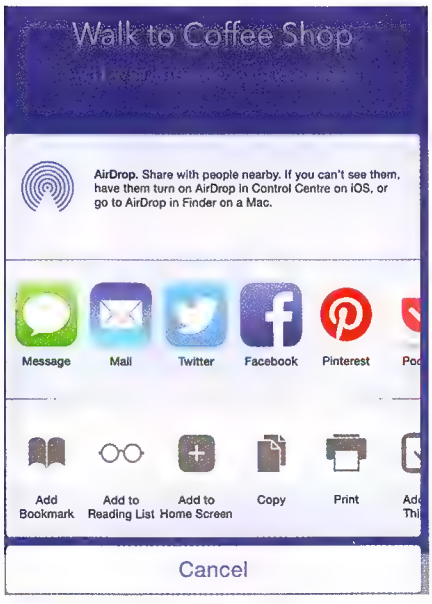
3 USING THE GALLERY

It's best to start by tapping Gallery and browsing the wide range of pre-made workflows. These are often useful, and give you an idea what the app is capable of. Tap the 'Walk To Coffee Shop' icon to see its details. Now tap 'Get Workflow' to add it to your workflows. You will return to the My Workflows screen with the workflow displayed as a large coloured icon.



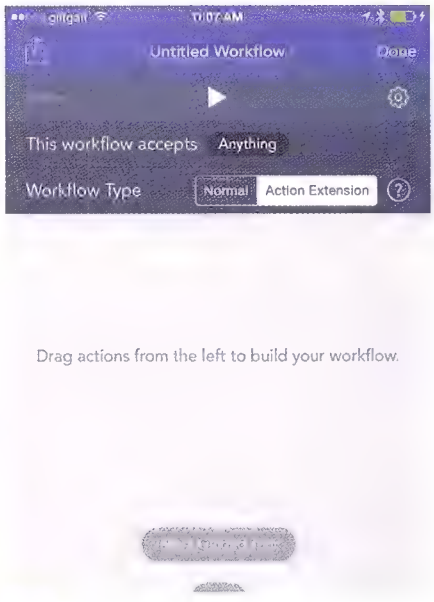
4 RUNNING A WORKFLOW

When you open a workflow you may see actions requesting access to iOS functions such as Photos or Location. Our Walk To Coffee Shop workflow uses an Action called Search Local Businesses (using Maps). Tap Grant Access, and Allow, to enable this action. Tap Play to run the workflow. As the workflow runs a menu appears, displaying local coffee shops. Select a coffee shop to view it in Street View then tap Done to get Map directions.



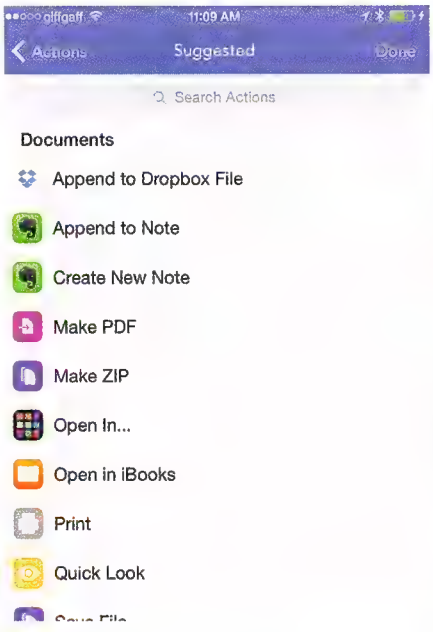
5 TURN INTO APPS

Next we are going to turn this workflow into its own app. Tap the Settings icon at the top-right of the workflow. In the Settings window you can rename apps, share them and change some of their functionality. For now, just tap 'Add To Home Screen' to open Safari with a web app. Tap the Share icon and Add To Home Screen, then Add. This creates an icon to the workflow on your iOS Home screen — tap it at any time to find coffee shops.



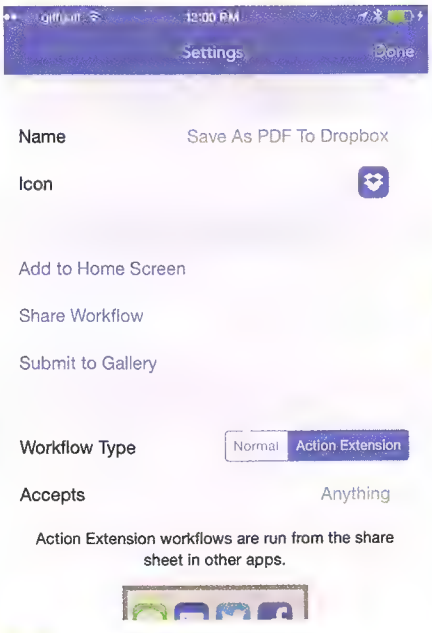
6 CREATING EXTENSIONS

Now let's create our own. Our own extension will be available in the Share option of Safari and will turn any web page into a PDF and save it in a Dropbox folder. Tap Add, to create a blank workflow. Now tap 'Action Extension', to reveal the 'This workflow accepts' option with the default of Anything (you can tap this to limit it to certain items). When you're ready, slide your finger from left to right to view the available actions.



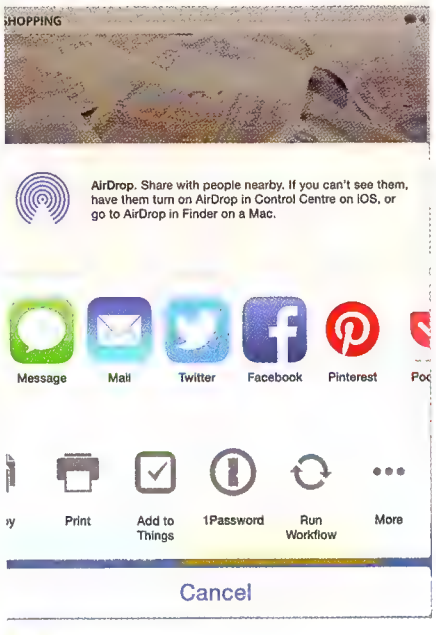
7 CREATE THE WORKFLOW

By default you see a list of Suggested Actions. We need two: 'Make PDF' and 'Save to Dropbox' (more options can be found by tapping the Actions button at the top-left). First drag 'Make PDF' to the right and add it to the workflow; slide back and drag 'Save To Dropbox' below. Notice the options under each item; set 'Ask Where To Save' to Off; tap Destination Path and enter `PDFs`. This will create a folder called PDFs and save files to it.



8 USING THE WORKFLOW

New workflows are called 'Untitled Workflow' by default. Tap 'Settings > Name' to rename the workflow (we've called ours 'Save As PDF To Dropbox'); tap Done. Next, tap Icon and use the Colour and Glyph tabs to pick a suitable icon for your workflow (we've used a blue Dropbox icon). Tap Done and Done again and your workflow extension is ready to use. If you tap Play in the Workflow app it doesn't do anything. We need to make it work in other apps.



9 WEB PAGE AS PDF

Open the Safari app and navigate to a page you'd like to save as a PDF. Tap 'Share > More' and set 'Run Workflow' to On; tap Done. You'll now see the Run Workflow icon on the right of the bottom row of Share icons (after 'Add to Reading List'). Tap 'Run Workflow' and a list of workflows appear. Tap 'Save as PDF to Dropbox,' and the workflow app will run through the web page. Open the Dropbox app and you'll find a folder called PDFs containing the pages.

Hack your wireless router

Matt Beilby gives a rundown on how to power up the device at the heart of your home network by installing a custom firmware.

Nowadays, a decent router can be relied on to do its own thing without bothering you, making it a great time for home networking. However, it can still be a challenge to get it to do your particular thing instead. If you're ready for a change, the world of custom firmware opens up an embarrassment of configuration choices, as well as an enticing catalogue of new functionality.

With DD-WRT as our firmware of choice, we're going to firmly encourage these sleek and unassuming embedded devices to reach their full huffing, wheezing potential. There will be sweat, there may be tears, but we'll guide you through the process of selecting and installing a firmware, show you some of the nattiest ways to trick it out, and open the door for your own challenges to follow.

DD-WRT is one among many custom firmware for wireless routers, but it beats at the heart of the custom firmware movement, with a broad range of support, relative ease of use, consistent development and a treasure trove of features. Installing DD-WRT isn't a minor tweak, though – it will completely rewrite the way your router operates, potentially opening up functionality, such as: SSH; file and media serving; guest networks; QoS; VLANs; and VPNs in more flavours than you could find in a bag of Skittles. However, there are risks commensurate with the scope of the change.

While installing a custom firmware is almost always a beautiful learning experience, sometimes what you learn is how it feels to break a perfectly good router. It probably won't even seem like it's your fault when it happens, but implicit in your willingness to continue is the understanding that it will be your fault, because you were the one who poked it.

Now that's clear, we can continue and the most advisable way forward is to use an older, spare router. Look at it this way – you're going to end this process without a manufacturer's warranty, so you may as well start it without one. You're also less likely to feel a sense of gnawing, visceral guilt if you sneeze and pull out the power adaptor during a firmware update, and proportionally more likely to unlock new features. By contrast, it can take a reasonably long time for custom firmware such as DD-WRT to adapt to new technology (and longer still to make it run reliably), so you may be on a hiding to nothing with this year's super router, even if you're cavalier enough to try it.

ROUTER SUPPORT

We'll deliver the bad news up front. With no notable exceptions, combination router/modems won't work. If you do have a standalone router, you can't necessarily just go ahead and plonk a new firmware on it. Some routers don't have the right chipset, some don't have enough flash storage, and some don't have the RAM. Some, frankly, don't have the moxie. All that said, a surprisingly wide range of routers are supported. So how do you know whether yours is one of them?

Your first port of call should be DD-WRT's router database (**www.dd-wrt.com/site/support/router-database**). Simply put your model number into the search field, and then cross your fingers. The database will usually give you a straight yes or no answer, but don't jump for joy when you see your model appear in this list until you have checked that the revision column also matches up with your router – some manufacturers change out the internals almost completely between revisions of the same router model.

Just for fun, try searching for the WRT54G in the router database, and count the iterations. The WRT54G is

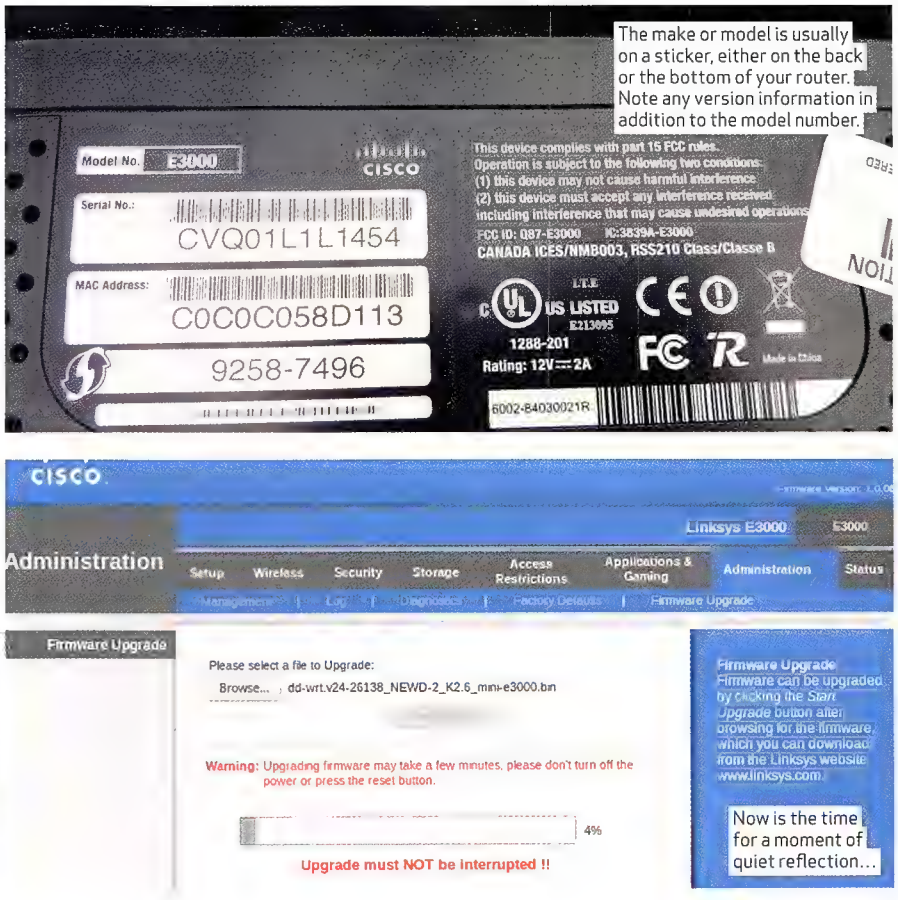
the granddaddy of DD-WRT, and it has a lot of history. But note that at least one revision isn't supported at all, and that the specs can be wildly different between others. Many have reduced flash storage space, for instance, and will be limited in which features they can support.

Once you've established that your router is supported, there are two major lights in the darkness: DD-WRT's wiki, and the community forums. The wiki is great for getting a baseline understanding of any issues which might affect your particular router. Start with the Supported Devices page (**www.dd-wrt.com/wiki/index.php/Supported_Devices**). Links from this page often indicate that your router has a specific installation guide, which might just mean that it's a popular model, but it could mean that the flashing process comes with some caveat or special requirement, so be aware.

FIRM FORUM FRIENDS

The forums are the best place to find out what's working, right now, for other people using the same hardware (see **www.dd-wrt.com/phpBB2**). You should pay particular attention to threads where users trade blows over their favourite or most stable builds. Look out for the guru posters, who often have long signatures containing details of the many different routers they run, and which firmware versions they're running on them. These guys have done their homework, so make sure you do yours, too, even if that sometimes means leaning across the metaphorical desk to copy their notes.

DD-WRT exists in an ongoing beta, and the newest release is not always going to be the best one for your own particular hardware. There's no shame or loss in using a build which might be significantly behind the bleeding edge. If it's the right fit for your kit, just go for it. With older releases, the main thing you need to concern yourself with is to make sure that you're not exposing yourself and your hardware to any critical security flaws. As a starting point, build revisions between 19163 and 23882 are a poor vintage; any components making use of OpenSSL will be affected by the Heartbleed bug. The good news is that none of the vanilla builds are affected by the Bash-specific Shellshock vulnerability; like many embedded device firmwares, DD-WRT relies on BusyBox to provide A Shell. Likewise, the use of uclibc means that the glibc Ghost vulnerability is no concern for today. However, running a custom firmware does tend to send the security ball into your side of the court, so you really do need to keep abreast of any emerging vulnerabilities.



Now, let's go through a worked example. We have a Cisco Linksys E3000 router, which treads a decent balance between age and relevance. It's around five years old and there's none of that new-fangled wireless AC technology, but it was a powerhouse in its day, with support for simultaneous 2.4GHz and 5GHz wireless bands. The router database shows a firm yes, and there is some specific information on the wiki relating to it. Particular points of note are the implications of it having 60K of NVRAM, and the requirement to flash a trailed build (see below for the box: Trailed Builds and TFTP). We'll need to take both of these things into account.

We're lucky, as it happens; on the forums, a build from February 2015 (build 26138) is being touted as stable with the Linksys E series. There's some debate about a bug in the Guest Wi-Fi implementation, but it sounds as though it's going to be worth our time.

The main area for new DD-WRT releases is at **ftp://ftp.dd-wrt.com/betas** and we know from the wiki that E3000-compatible builds are to be found in the broadcom_K26 subfolder. We can pick a mini-trailed release for the E3000 from here with no problem, so we'll get that now, but if we want to move to a larger general build afterwards, then we'll need to remember our 60K NVRAM limit, and pick one of the 60K builds from the same folder. The mega 60K build is (just!) too large for our 8MB flash storage. It's a good job we checked that out, because it came down to counting the bytes – so we'll go with the so-called 'big build' instead.

FIRMWARE UPDATE TIME

Now it's time for us to check and double-check all our sources of information, because we're ready to do the firmware update. The steps that follow are usually applicable, but you should read up on your model to see where any differences might occur.

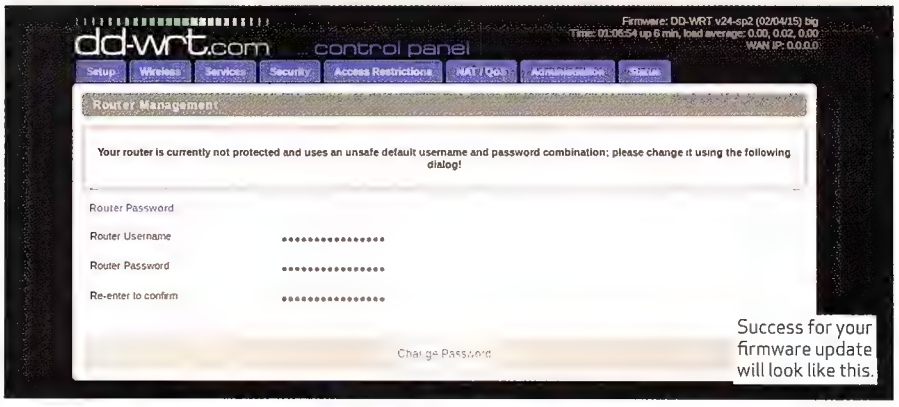
First, you need to connect your computer to the router using a wired connection, and then configure it to have a static IP address on the same subnet as the router. Things are not guaranteed to go wrong if you don't do this, but do you really want to leave the router in charge of business while you're in the process of brainwashing it? The answer is a definite no. No, you don't.

Do a 30-30-30 reset (see below), and then log in to your router's web configuration page (with the now factory default username and password). Find wherever your manufacturer has hidden the firmware update section, and browse your computer to find the DD-WRT firmware file you prepared earlier, which is probably a trailed build specific to your router.

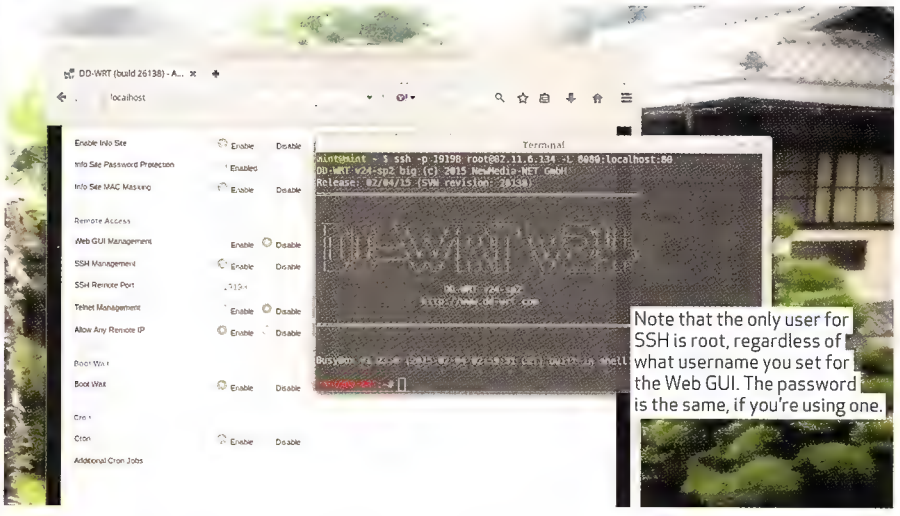
Go ahead and do the update using the built-in firmware updater. There may or may not be a progress bar, but ignore it either way. You're going to wait at least five minutes. Use a clock and not your patience to gauge this. Then turn the router off and on again, giving it time to reboot and get its bearings — then, and only then, do another 30-30-30.

Open up a web browser and go to 192.168.1.1, which is the default IP address for a DD-WRT router, and check that you are indeed looking at a DD-WRT interface. That's the first good sign, and the second is whether it's asking you to change the password, which shows that the 30-30-30 reset after the update has also worked properly.

If all is well, decide whether you're sticking with the build you've just installed or, if you were using a trailed build as an intermediary step, repeat the process again in full, until you have reached your final destination.



Success for your firmware update will look like this.


Note that the only user for SSH is root, regardless of what username you set for the Web GUI. The password is the same, if you're using one.

CONFIGURATION WORK

Now that you're up and running, feel free to do some basic configuration. Get the router set up the way you like it; that's what we came here for. DD-WRT's interface is neat and functional, and you should be able to find the options you're comfortable with, albeit buddying along with a raft of new features. Get your wireless security set up, and then give it a test drive. Now are you ready to try something that you couldn't do before?

How about logging directly into your router via SSH? Yeah, we can do that. We can even do it without a password, using the public key method. To generate an appropriate public/private key pair, enter the following into a terminal on your local machine.

```
ssh-keygen -t rsa -f ~/.ssh/id_rsa_ddwrt
```

You're prompted to set a passphrase, but hitting Enter twice enables you to continue without — choose your balance of security and convenience. Two new files are created under your home directory, in the ~/.ssh/ hidden folder: id_rsa_ddwrt and id_rsa_ddwrt.pub, which contain your newly generated private and public keys, respectively.

Make sure you keep prying eyes away from the private key, but we'll use the public key to set up easy password-free access to your router.

Go to the Services tab in your new DD-WRT Web GUI, and then click the enable checkbox for SSHd. This expands some new options. It's up to you whether or not you leave password authentication active, but what you do want to do is copy the contents of your id_rsa_ddwrt.pub file into the Authorized Keys box. Make sure the entire sequence occurs on a single line. Save and apply these changes. At this point, one simple terminal command on your local machine should let you in through the door:

```
ssh root@192.168.1.1
```

Substitute in the correct local IP of your router, if you've changed it. If you see the DD-WRT message in the terminal, well done, you're in. But you didn't think we were going to stop there, did you? Getting the local access is only half the battle. How about an interesting and powerful way to manage your router from the outside

Trailed builds and TFTP

A trailed build could quite accurately be described as a custom custom firmware. It's a firmware that's been built specifically for one particular model of router (which is mentioned in the filename). Trailed builds contain headers that check out as legitimate with the manufacturer's own firmware, which then conveniently and quite cleverly enables you to use the existing interface to overwrite itself. A trailed build might not be your end point, however, but more like a transitional step between using stock and custom firmware. Once you have installed a trailed build of DD-WRT, you're generally able to move more freely between different firmware builds — you still need to pick the correct ones, though.

Now let's take a look at tftp, which is quite literally a trivial file transfer protocol. This is necessary for the initial flash of a few routers — older Linksys, Buffalo and Belkin models being the prime examples. It's comparatively rare to require this on Wireless N or newer routers. If you don't need to use tftp, then it's not recommended, regardless of whether or not it's available.

However, it's worth remembering that lots of different routers have a tftp connection available for a limited window during the boot process, because it could be one of the first ports of call if you need to try to recover from a bad flash. Although it's never to be relied upon, it may help bring you back from the brink in a pinch.

The 30-30-30 reset

Don't underestimate how skew-whiff things can become when the vestigial variables of firmware A come out to play with custom firmware B. The 30-30-30 is a catch-all hard reset for clearing NVRAM and returning most routers to their firmware defaults, which you'll do before and after flashing each new firmware version.

Your router's Reset button is probably on the back of the unit, sometimes inset. Grab a paperclip if you need one, and get into a comfortable position; you are going to be holding your router's reset button down for 90 seconds or more, which is a long, long time for someone with cramp.

Start holding down your router's reset button, and count a full 30 seconds. Not letting go of the reset button, pull the AC plug out of the back of the router. Count 30 more seconds. Keep holding that reset button, and plug the router back in. Count 30 more seconds. Finally, let go of the reset button and throw up some jazz hands to brighten the mood and get your circulation flowing again. Your router should be back to default values for whichever firmware you currently have installed. (You can put your hands down now.)

A handful of older routers, but an ever-increasing number of new AC routers, need to be hard reset in other ways. If the 30-30-30 doesn't return yours to default values, check what does work for your router, and use that method instead.

Yes, you can buy a tool that does the job of a paperclip.

world? Remote access to your router is always going to be a controversial subject but, let's be honest, sometimes it's useful enough to be worth the risk you are taking doing it.

DD-WRT will happily support remote access to the GUI via HTTP or HTTPS. There's no way in this life that you'd want to give the world a shot at the core of your home network without a single security layer, but you might be thinking about allowing HTTPS connections.

Wait, though. Here's a neat trick instead: why not disallow remote Web GUI access altogether, and just connect via SSH? You can then log in and administer the router remotely by command line or set up an SSH tunnel to give you, effectively, local access to the Web GUI. This will work from any location – and you only have to open one door to enable both types of access. Let's look at how this can be done.

First, setting up the remote access to SSH is done in a different part of the DD-WRT GUI to enabling the service. This time you'll want to go to the Management tab under Administration. There's a remote access section here. Don't bother enabling the remote Web GUI Management. Instead, enable SSH Management. You're given the option to select a port for this. You don't need to – and, in fact, shouldn't – use the typical SSH port 22; we'll use port 19198 in this example. We made this up so feel free to make up your own, but don't worry – the connection made on this port will forward through to the SSH service on your router without any extra work on your part.

Now you can SSH to your router from the outside world, in the same way that you do from your local network – the only differences are that you need to specify the port, and use the outward facing IP rather than the local one:

```
ssh -p 19198 root@WANIP
```

You should replace WANIP with the global address of your local network. This can be a DNS name, or an IP address. In the highly likely event that your ISP doesn't provide you with a static IP address, you won't necessarily need to keep track of every change of IP address. DD-WRT supports automatically updating of a number of different dynamic DNS services – take a look at DDNS under the Setup tab for the various options.

So we've come this far, but what about that Web GUI? Well, try starting your SSH session with this command:

```
ssh -p 19198 root@WANIP -L
8080:localhost:80
```

This starts an SSH session as before, but the last part of the command creates a tunnel from port 8080 on your local machine, to port 80 on the router. Now try opening a browser window to the following URL: **http://localhost:8080/**

Wow. Presto. There it is. You've got your Web GUI from a remote location, and it's all encrypted through your SSH session. Now the world, quite literally, is at your disposal.

THE GAUNTLET

Now you've got access via the Web GUI and SSH, what new things are worth trying? Actually, what new things are not worth trying? If that sounds like a challenge, read it as one.

How about building on the SSH tunnelling method we looked at, to have your home router run a SOCKS5 proxy, via which you can encrypt your traffic when you're away from home? If you've got a VPN account, how about connecting with your router as the client? (This can be great for hooking up other, less hackable embedded devices which might not support VPN natively.) Maybe you have a USB mobile broadband dongle? DD-WRT can play with those. Why not try creating an alternative internet feed through your router, for those days when your main ISP connection dies?

If you really want to start playing with fire, you might even find a way to host your own cloud-style file service from a USB hard drive, hanging off the back of your router. It's not like you were planning on turning your router off, were you?

So there we have it. Some absolutely astounding possibilities that would previously have taken all kinds of wizardry to arrange, running on something you probably already had sitting in a cupboard. Remember that routing network traffic is this device's bread and butter, so don't be afraid to make it earn a living!

Get more from Spotlight

OS X's built-in search tool is a powerhouse utility that can do much more than search. Matthew JC. Powell shows you how.

Spotlight – the search utility you open by clicking on the magnifying-glass icon in the top-right corner of your Mac's screen – has been part of OS X since Tiger, aka OS X 10.4. It has come a very long way since those rudimentary beginnings though, and in Yosemite (OS X 10.10) it should be a central part of your workflow.

Reflecting the enhanced power and functionality of Spotlight in Yosemite, its interface is no longer a simple drop-down menu in the corner. Now when you click on that magnifying glass, a window opens smack in the middle of your screen, like a real application. That disjuncture, clicking in one part of the screen to make something happen in another part of the screen, can be quite off-putting though – so I recommend using keyboard shortcuts.

The first and most important keyboard shortcut to know is 'Command-space'. This activates Spotlight without you having to click anywhere. Faster and less crazy-making.

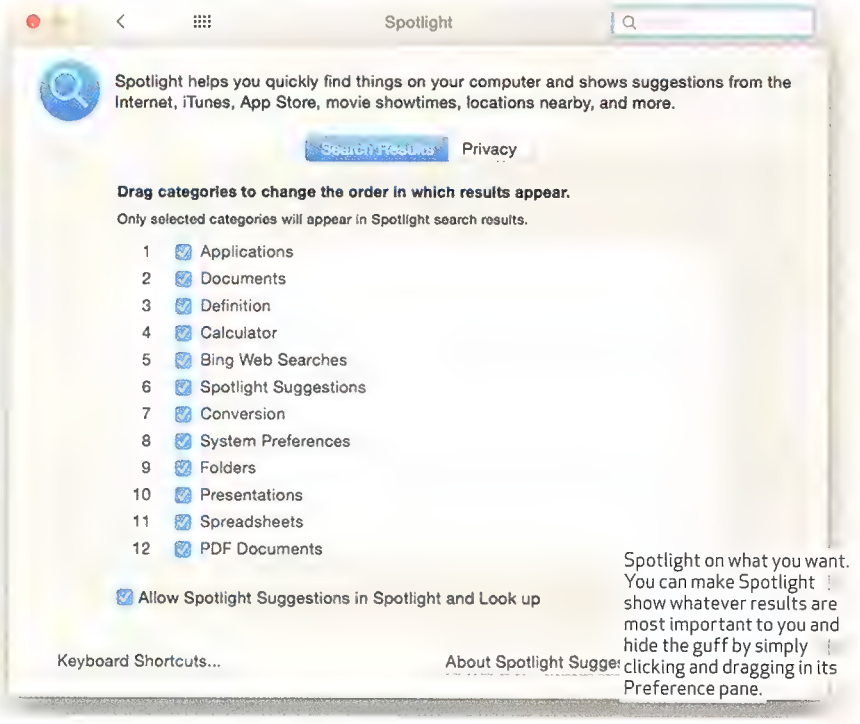
Next, type something into the search field. Your results are grouped by type, with Applications the top of the list, then Documents and so on. This makes Spotlight a very quick way to launch an application: press 'Command-space', then type the first few letters of the name of the application you want to use, and hit return to open it.

Likewise, if you want to open a document, simply scroll down the list of results to the document you want to open and hit return, and it will open in its default application. (Extra tip: new in Yosemite, you can drag search results from the Spotlight window to an application's icon to open files – handy if you don't want to use the default application.)

Ah, but what if you actually want to just find something, and not open it? Easy. Select an item in the list of search results and press the Command key – at the bottom right of the Spotlight window you'll see the item's location as a path.

Or, to make it even easier, press 'Command-return' and a Finder window will open with the item highlighted. (Pressing 'Command-R' – the default "Reveal in Finder" command in many Apple applications – will perform the same function.)

On the money. If you want to convert between something other than your local currency or one of the defaults, you can simply type in plain language.



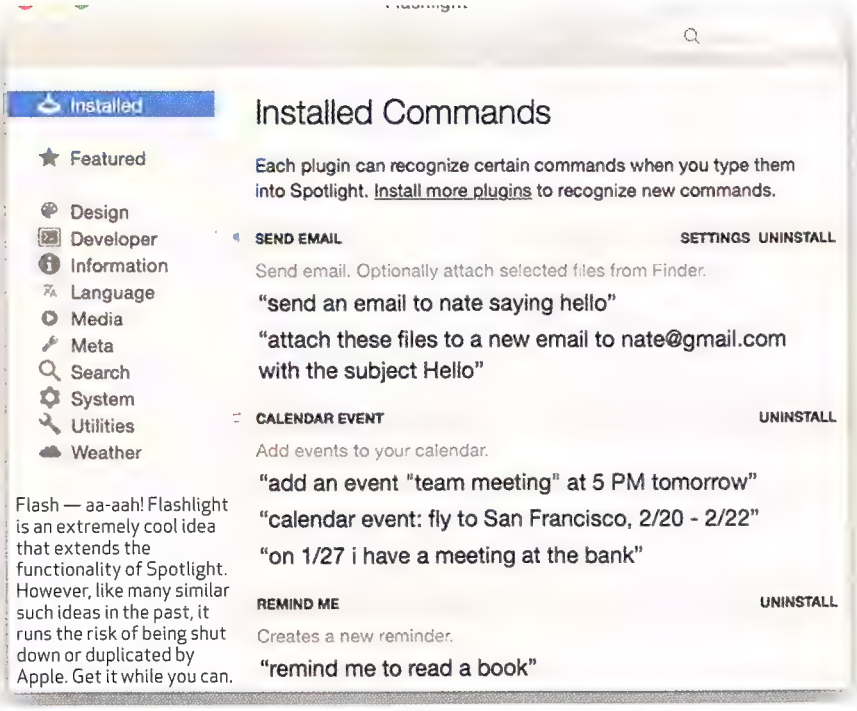
Spotlight on what you want. You can make Spotlight show whatever results are most important to you and hide the guff by simply clicking and dragging in its Preference pane.

Spotlight can also search the Web. Wikipedia results are shown in the Spotlight window itself, but if you want to do a broader search, type in your search term and then press 'Command-B' to open your default browser and perform the search using your default search engine.

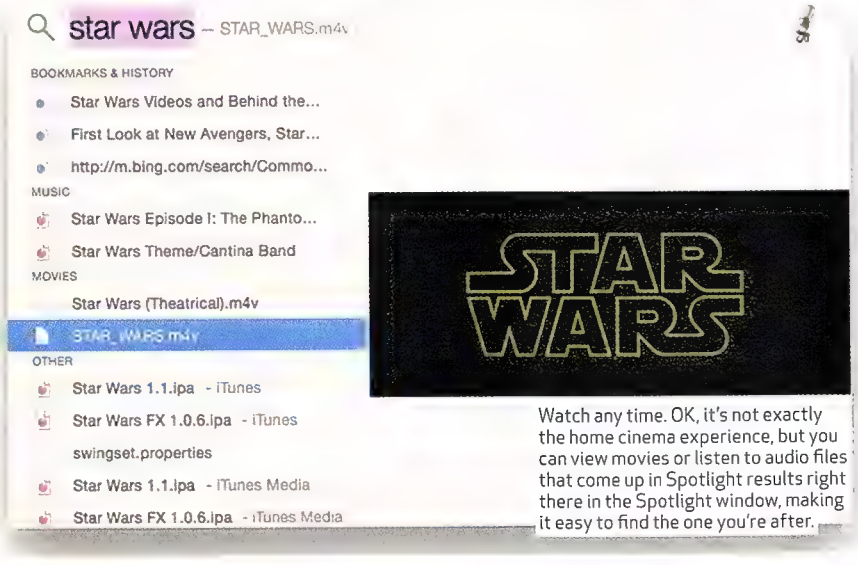
And if you want to clear the Spotlight search field, press 'Command-period'.

Incidentally, if among your search results is a media file – video or music – you can play it right there in Spotlight without having to open iTunes or QuickTime Player. Select it, then hover the mouse pointer over the preview in the right half of the Spotlight window. You only have play and pause controls, but it's handy if you're just reviewing to make sure it's the file you're looking for.

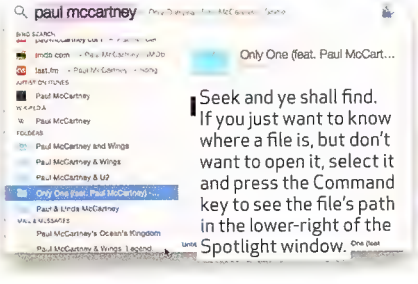
Spotlight is also a quick way to access



Flash — aa-aah! Flashlight is an extremely cool idea that extends the functionality of Spotlight. However, like many similar such ideas in the past, it runs the risk of being shut down or duplicated by Apple. Get it while you can.



Watch any time. OK, it's not exactly the home cinema experience, but you can view movies or listen to audio files that come up in Spotlight results right there in the Spotlight window, making it easy to find the one you're after.



Seek and ye shall find. If you just want to know where a file is, but don't want to open it, select it and press the Command key to see the file's path in the lower-right of the Spotlight window.

the OS X Dictionary. To jump quickly to the Dictionary result for a term you've searched, press Command-L.

As well as a dictionary, Spotlight is a brilliant calculator, including currency conversions. Type a currency amount in the search field and Spotlight will guess that what you want to know is how much that means in your local currency and a range of other major world currencies. You can use symbols (€500) or plain language (500 euro) and Spotlight understands.

But that's not all the mathletics it can do. Type in an arithmetic problem such as 24+15*2-32/4+(18+6) and it will return the correct answer (70) – it understands order of operations. It also understands certain mathematical constants such as e and pi, and functions such as square root (type "sqrt(25)" to get "5") and logarithms and more.

Basically you have access to the full maths library built into OS X's Unix underpinnings. An exhaustive list of supported functionality would not fit here, so if you're interested open a Terminal window and type "man math" (without quotation marks) to find out all of what a Spotlight window can do mathematically.

CUSTOMISE SPOTLIGHT

As mentioned above, your results in a Spotlight search are grouped by type. You can customise what types of results are returned, and the order in which they appear, by opening the Spotlight pane of System Preferences. All categories are on by default, but to remove one, simply deselect it. To change the order in which they appear (if you want dictionary definitions ahead of Documents, for instance, simply click and drag them into the order you want.

EXPAND SPOTLIGHT

As if the range of tasks Spotlight can already perform were not impressive enough, a clever group of developers has figured out a way to use Spotlight to trigger Automator actions, turning it into a veritable text-based powerhouse.

First you need to download a utility called Flashlight from **flashlight.nateparrott.com**. Once installed, Flashlight acts as a sort of plug-in platform for Spotlight. Things you type into Spotlight trigger actions in Flashlight, which then runs the Automator scripts.

For example, you can type "Reminder pick up bread tomorrow after work" and a Reminder will be created containing the text "pick up bread tomorrow after work" (and of course, if you use an iPhone, that Reminder will appear on your iPhone too). All without having opened the reminders app at any point.

> "You only have play and pause controls, but it's handy if you're just reviewing to make sure it's the file you're looking for."

Some of the plug-ins written for Flashlight are a tad esoteric, and many are redundant, duplicating functionality already found in Spotlight. Nonetheless, it has the potential to be very exciting – at least until Apple shuts it down.

Build a Pi 2 server

Les Pounder uses the fancy new Raspberry Pi 2 board to build a tiny but power-efficient server for his growing digital library.

Traditionally, servers are great big devices that consume vast amounts of power and generate a considerable amount of heat, and that is why data centres are huge air conditioned rooms full of racks housing multiple units. But for home or small business use, they don't have to be that way anymore, and with the Raspberry Pi we have a small Linux computer that consumes very little power and generates only a small amount of heat. In this tutorial, we will be using a Raspberry Pi 2 to build a small, powerful and energy efficient server that will serve files over SSH and be a handy remote backup location.

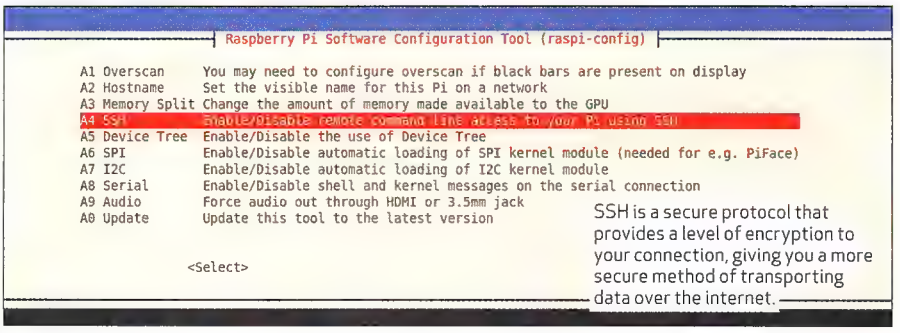
Aside from the Pi, you'll need to collect together a blank Micro SD card, a good-quality Raspberry Pi power supply, an Ethernet connection to router and an externally powered USB hard drive. We'll start by creating an SD card containing the operating system. Technically, this is a bundled collection of software based on the Linux kernel that's called a distribution or 'distro' for short. Our distro of choice is Raspbian, which is the default distro for the Raspberry Pi.

There are two ways of installing Raspbian to your SD card. First, the NOOBS method requires that you download the NOOBS ZIP archive and then extract the contents to a blank, FAT formatted card. Once this card is inserted into your Raspberry Pi, a menu system will ask you which distro to install; this is where you should choose Raspbian, and then grab a cup of tea while it installs itself. This is the easiest way of installing Raspbian, but for a smaller install footprint the best method is to download the Raspbian image and then extracting it from the archive, copying that to a blank SD card and using the command dd.

The dd command is powerful but dangerous. If used incorrectly, it can destroy all the data on a drive, so proceed with care. Before employing dd, we need to identify the SD card inserted into the computer. Open a LXTerminal (click on the icon on the desktop) and type the following:

```
sudo fdisk -l
```

You will now be able to see a list of the volumes/disks that fdisk can find. Typically, anything starting with '/dev/sdX' is an internal hard drive of your computer. Ignore those entries and look for '/dev/mmcblk0XX', where XX can be p1 or p2. You can ignore p1/p2, as they are partitions on the card – we will be writing data to the whole card, not just a partition. If you can see those, your SD card has been identified and make a note of the location.



With the SD card found, we use the dd command to copy the Raspbian image to the blank card. In the LXTerminal, navigate to the location where you extracted the Raspbian image from the ZIP archive; typically, this is Downloads.

```
cd ~/Downloads
```

Now issue the dd command. Double check everything before pressing enter, as once you start dd it won't give you a chance to stop the process. In the LXTerminal, issue the following command, replacing raspbian.img and /dev/mmcblk0 to match what your system reported via the fdisk -l command.

```
sudo dd if=./raspbian.img
of=/dev/mmcblk0 bs=4M
```

You will be prompted for your password and then dd will get to work, but you will see no output while it works; rather, it will do its job and then report after five to 10 minutes. Now is the time for a cup of tea.

SETTING UP RASPICONFIG

With your SD card ready, lets assemble your Raspberry Pi setup. For this initial configuration step you will need to plug your Pi into a monitor and have a keyboard and mouse connected. Assemble your kit, insert the SD card and then power up your Pi. The boot process on the Pi 2 will take less than 15 seconds, and when it's finished you'll be transferred to the raspi-config screen. Your first task is to expand the filesystem on the SD card so that you get the maximum amount of space. To do this, navigate to option 1 and press Enter to start an automated process. With that complete, navigate to option 8 – Advanced options. Now navigate to A3, Memory Split and press Enter. Change the value to 16 and press Enter. This gives you 16MB of RAM for the GPU. As you'll be using this headless, you won't need a lot of video RAM. You'll be returned to the main menu, but you need to navigate back to the Advanced menu – option 8. In the Advanced menu, navigate to A4, SSH, move the cursor to Enable and press Enter. That's our configuration done. Return to the main menu, navigate to Finish and press Enter. Reboot your Raspberry Pi to finish the configuration.

With the Pi rebooted, go ahead and log in. The default username is pi and the password is raspberry. Next, make sure that your software is up to date. At the LXTerminal, type in the following and press Enter.

```
sudo apt-get update
```

This will compare your software repository lists against what is on the Raspbian servers and updating where it needs to. If there is a lot to download, Raspbian will ask before it does so. Depending on your internet speed, this may take a while, but once it's done control will be returned to you.

GETTING A FIXED IP

With the updates complete, you can now create a fixed IP address for the Pi server. To do this, you will need to edit the /etc/network/interfaces file. You will need to know the current IP address of the Pi, which you can find by running:

```
ifconfig
```

This will spit out a lot of text. As you're using the Ethernet connection, look for the eth0 line, typically at the top of the text. In this section, look for the inet addr: Ours looks like this:

```
eth0      Link encap:Ethernet
HWaddr b8:27:eb:b8:d2:c8
inet addr:192.168.0.6
Bcast:192.168.0.255
Mask:255.255.255.0
```

We also need to run netstat to get more details:

```
netstat -nr
```

And pick out two numbers from here for the gateway and the destination. Make a note of both.

So with this information noted, edit the /etc/network/interfaces config file.

```
sudo nano /etc/network/
interfaces
```

The default configuration will show that interface eth0, Ethernet, is using DHCP (Dynamic Host Configuration Protocol). In other words, it gets an IP address each time it connects to the router: `iface eth0 inet dhcp`

In order to keep track of where our Pi server is on the network, we will fix its IP to what we found in ifconfig, which in our case was 192.168.0.6, but yours will differ. We will make changes only to the iface eth0 section; the other sections must be left as they are.

Our new section looks like this, yours will reflect the setup of your network:

```
iface eth0 inet static
#The IP address that we wish
to use
address 192.168.0.6
#This is used to divide IP
addresses into subnets, this
is the standard and will work
for you
netmask 255.255.255.0
#This is the IP address
structure for our network,
yours might be 192.168.1.0
network 192.168.0.0
#We found this via ifconfig
earlier it was labelled BCAST
broadcast 192.168.0.255
#This is the gateway address
that we found in netstat -nr
gateway 192.168.0.1
```

When you're ready, save the changes by pressing Ctrl-O, then exit using Ctrl-X. Reboot your Raspberry Pi by typing: `sudo reboot`

Create a network printer

Typically, we have multiple computers in our home but when we want to print we only have one printer necessitating us to plug in to print a document. What if we could create a central network printer using our Pi server? Well, we can using CUPS, Common Unix Printing System a printing service created by Apple and used on OS X and Unix systems around the world.

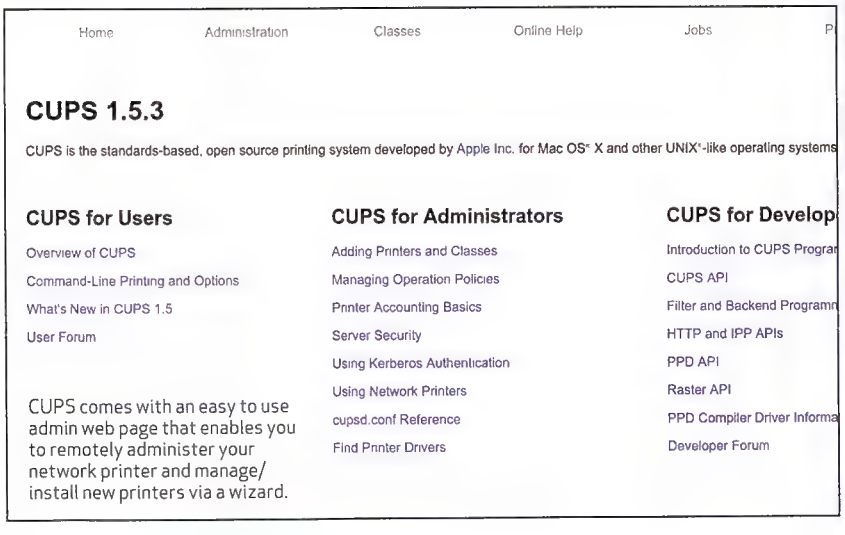
Typically we run a version of CUPS on our computer but we can also instruct our computer to print to a network printer. To install CUPS you will need to SSH into your Pi server and type into the LXTerminal the following.

```
sudo apt-get install cups
```

You will then need to complete a few configuration changes. We found a great guide for this on How-To Geek (**tinyurl.com/qzq6zbl**) that illustrates how to complete this task on your Raspberry Pi. To administer a remote CUPS printer all you need to do is open a browser on your computer and type in the IP address for your Pi server and append :631 to it:

```
192.168.0.6:631
```

You can then add new printers, check the status of print jobs and cancel any erroneous prints. You can even set up an extreme remote print job by using port forwarding on your router to forward print jobs from outside your network to the CUPS printer.



Your Raspberry Pi will reboot and return you to the login prompt. Log back in and type: `ifconfig` to check that your IP address is now static; if you want to check that you have internet access, type the following:

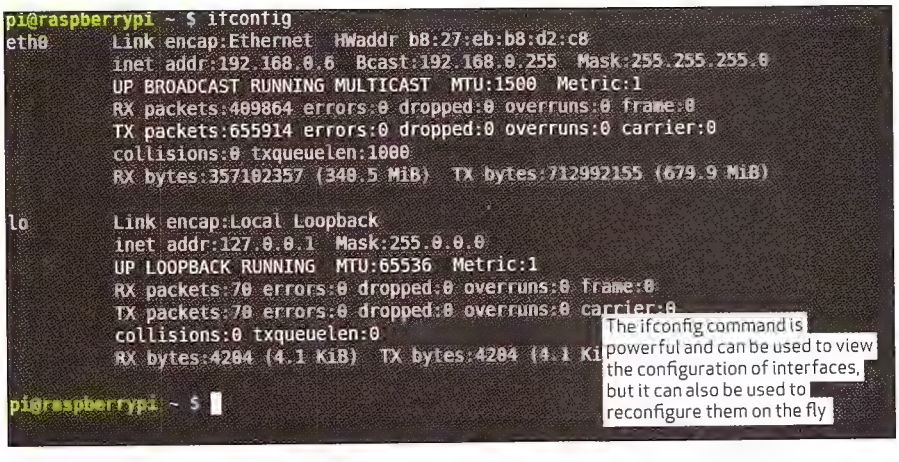
```
ping google.com
```

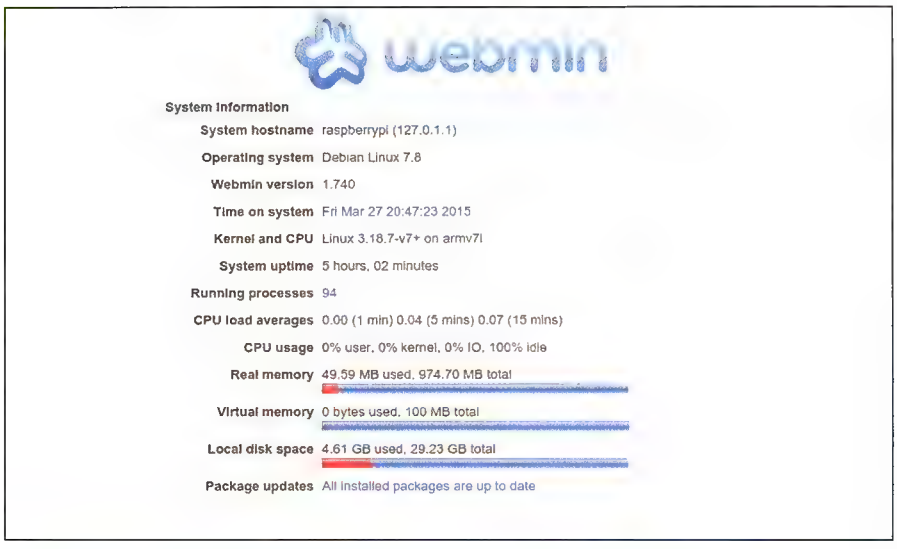
If the pings return properly, you've configured the network settings correctly. At this stage, you can carry on using the keyboard and monitor or you can go headless and connect to your Pi server over the network. We chose to log in via SSH from our Linux Mint laptop. If you are going to do the same, you will need to open a terminal on your computer and type:

```
ssh pi@IP ADDRESS
```

Remember to replace the IP address with the static address that we used previously. You will need to provide your password before you can log in, but once successful any command issued will go through on the Raspberry Pi.

With your system built, you now need to configure it to act as a server, and the first task is to enable Raspbian to read and write our USB 2.0 external hard drive. If a drive is formatted as a typical Linux filesystem – ext3, ext4 or btrfs – you can read the drive with no configuration necessary. But because this drive is formatted NTFS – a Windows filesystem – you need to install a tool to enable read and write





"To make administrating a server a little easier, there's a great tool called Webmin"

access to the drive, and this is called NTFS-3G. To install, type the following into the LXTerminal:

```
sudo apt-get install ntfs-3g
```

It will take a few seconds to install, and when complete, control will be returned to you.

INSTALL WEBMIN

Administrating a server is traditionally undertaken via the terminal, in our case LXTerminal. In fact, we've done quite a lot of this already. However, to make administrating a server a little easier, there's a great tool called Webmin. This is a web interface for common administration tasks, such as user management and updating software.

To install Webmin on your Pi server, you will need to use the APT package manager to download Webmin and its dependencies.

```
sudo apt-get install webmin
```

With Webmin installed, open a new browser window on your computer and navigate to the IP address of your Pi and use the port number 10000. Our IP address looked like this: `https://192.168.0.6:10000/`.

You may receive a warning that the certificate for the web site isn't to be trusted. If so, don't worry, just click on Advanced Options and proceed onwards. You will next see a login screen – enter the username and password that you have used to log in to your Pi previously.

Once logged in, you will see the main menu split into eight sections. For this project, you need to refer to the System section, which contains controls for managing hard disks and for managing users and groups.

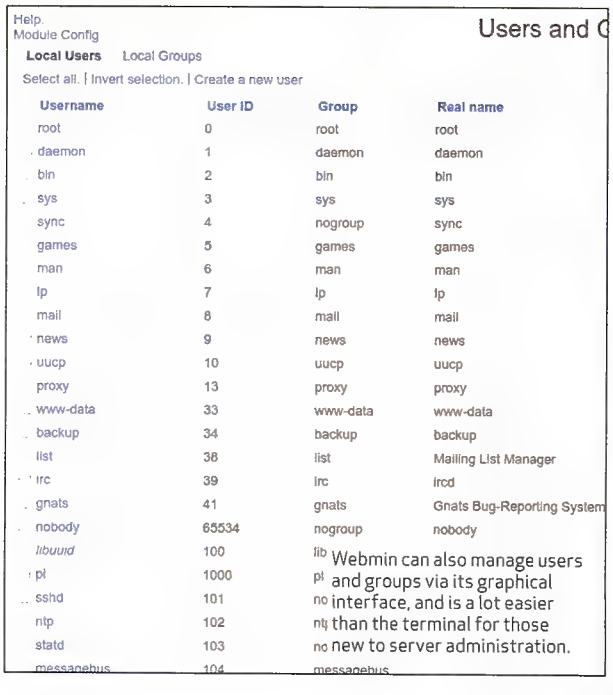
The next task is to mount the external USB hard drive on boot, so you will need the USB drive plugged in to the USB port of the Raspberry Pi. Before you manage the drive with Webmin, you will need to return to the LXTerminal and create a directory that will act as a share point. In the terminal, navigate to /media/ and create a new directory called drive, as follows:

```
cd /media
sudo mkdir drive
```

Accessing your Pi server

In this project we've created a file server inside our home network that's not accessible to anyone outside. If you would like to enable your Pi server to be accessed by external users then there are a number of things you'll need to do and to help we have compiled a handy checklist to follow:

- Change the default password for the Pi user you want to give acess to. You can do this using the passwd command in LXTerminal.
- Create a new user with no sudo or root privileges, the easiest way to do this is via the 'System > Users and Groups' menu.
- Set up port forwarding on your router so that requests to your external IP address are forwarded to the Pi Server. This is a little different for every router, so please consult your router manual.
- It's likely that your ISP does not provide a static external IP address. If that's the case then install noipclient, which you can download from **tinyurl.com/oevm9py** and also create an account on its web site (**www.noip.com**). The client software will update your IP address to a URL that you create on the web site, which will enable you to easily connect to your server without using an IP address.
- Last, it's really important to set up a firewall that will protect your server from external interference. The easiest way to do this is install fwbuilder and VNC on the server as fwbuilder is a GUI application to set up the firewall rules.



Webmin can also manage users and groups via its graphical interface, and is a lot easier than the terminal for those new to server administration.

With the directory created, you now have an issue: only users with sudo access, or root, can use the directory. You need to change the permissions so that users can read and write to the hard disk. To do this in the LXTerminal, type the following:

```
sudo chmod 770 ./drive
```

That's it for now in the terminal, so let's return to Webmin.

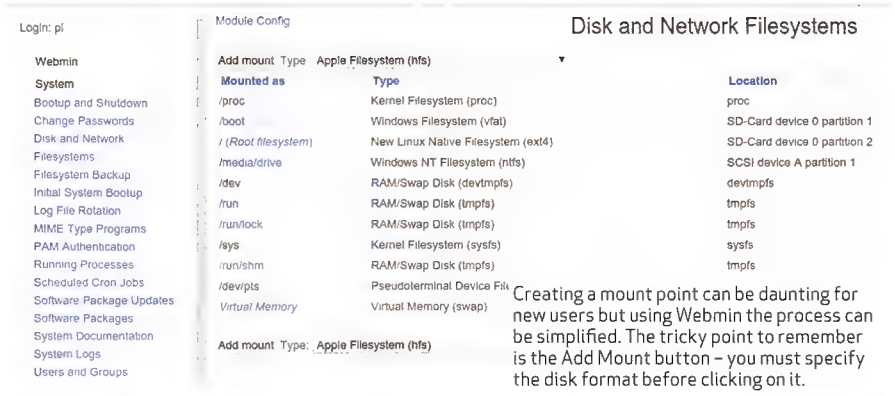
MOUNT DRIVE ON BOOT

To manage USB drives with Webmin, click on the System drop-down menu on the left of the screen, then click on Disk and Network Filesystems. After a few seconds, the screen will change and a list of all the mounted filesystems will be displayed. Our drive will not be listed, so we need to create a new mount using Add Mount; but before you click on the button, look to the right and you will see a drop-down labelled Apple Filesystem (HFS), click on the drop-down and select Windows NT Filesystem NTFS if your drive is formatted using NTFS. If not, select the format of your drive accordingly. Once selected, click on the Add Mount button to open a new menu.

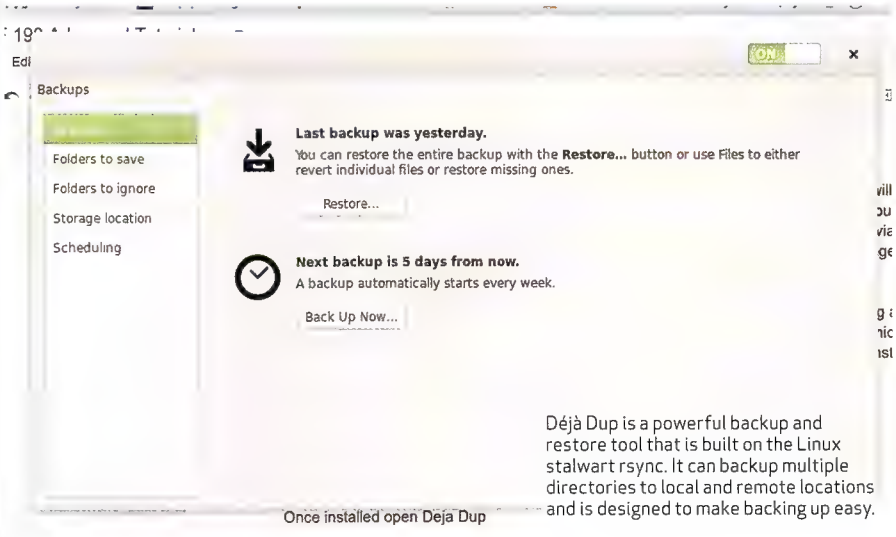
In the new menu, start by clicking on 'Mounted As' and its ... button to the right. This will open a dialog box where you can navigate to the /media/drive directory that we created earlier. For the rest of the configuration, just follow this simple checklist:

- Save Mount? Save and Mount at Boot.
- Mount Now? Mount.
- Windows NT Filesystem: Disk. Look for your device in the dropdown menu.
- Mount Options.
- Read-only? No
- Allow users to mount this filesystem? Yes
- Disallow execution of binaries? If mountable by users
- Avoid updating last access time? No
- Buffer writes to filesystem? Yes
- Disallow device files? If mountable by users
- Disallow setuid programs? If mountable by users
- Wait until network interfaces are up? No
- User files are owned by: Leave blank
- Group files are owned by: Leave blank

When you're ready, click on Save to write these configuration settings and mount the drive. The drive will now be available for you to connect to over the network. If you are using Ubuntu or Linux Mint, you can use the file manager to connect to the server, but you can also use Gigolo. (A rather blunt name, we note. It's tagline is "It mounts what it is told to." Classy.)



Creating a mount point can be daunting for new users but using Webmin the process can be simplified. The tricky point to remember is the Add Mount button – you must specify the disk format before clicking on it.



Déjà Dup is a powerful backup and restore tool that is built on the Linux stalwart rsync. It can backup multiple directories to local and remote locations and is designed to make backing up easy.

Once installed open Deja Dup

This is a graphical front-end for the virtual filesystem GIO/GVFs, which mounts remote filesystems and opens them in your file manager. This will be available via your software repositories.

BACK UP USING DEJA DUP

For the final part of this project we will use our Pi server as a remote backup device, with a great piece of open source software called Déjà Dup (**launchpad.net/deja-dup**). This is actually a graphical front-end for the flexible, speedy and scriptable rsync, which has grown into a standard Linux utility since its first release back in 1996. It makes backing up really easy to do. To start with, you will need to install Déjà Dup on our computer. You don't need to install anything on our Pi server.

On your computer, open a terminal and type:

```
sudo apt-get install deja-dup
```

Once installed, open Déjà Dup and you will be presented with the Overview screen. You will need to instruct Déjà Dup what folders you wish to back up, and that's in the Folders To Save option. Once you have done that, move to the Storage Location menu and fill in the details for your Pi server, including the location to store your backup. We used /media/drive/Documents, which was an existing folder on the drive. With that complete, you are ready to navigate back to the Overview and click on Back Up Now.

Your first backup will take longer than subsequent backups, due to the way Déjà Dup works. The first backup is a full backup of the directories that you have selected, whereas future backups will be partial to cover changes to the files. To restore from a backup, go to the Overview menu and click on Restore... and follow the wizard.

So there we have it, we have built a server that uses very little power but centralises our files and provides a remote back up solution for our ever-growing digital lives – all thanks to the Raspberry Pi and a little Linux know-how.

If you would like to know more about Webmin, head over to **www.webmin.com**, follow the official documentation and use the wiki for any questions.

Build an Android microscope

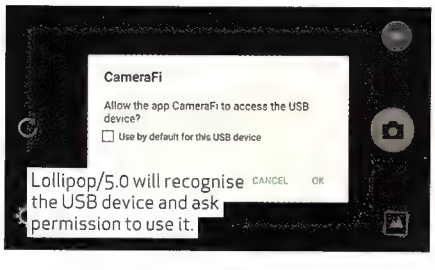
Carry a science lab in your pocket and add a USB microscope to your Android device. Darren Yates explains how.

Acer's Iconia Tab A200 works nicely with the DashCam app on Google Play.

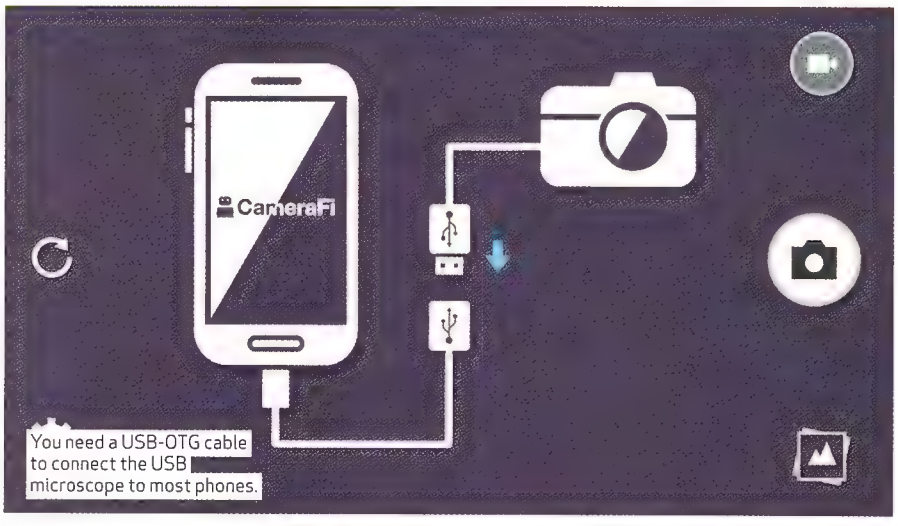
Getting greater numbers of the next-generation interested in STEM subjects (science, technology, engineering and mathematics) is one of the conundrums facing educators around Australia at the moment. Enrolments in these subjects have fallen steadily over the 20 years between 1992 and 2012, according to a recent report from the Queensland University of Technology, with its authors suggesting reasons most likely include students self-perception of ability and perceptions of subject difficulty and usefulness' (tinyurl.com/qutstem). That's such a pity, because I can't think of four more interesting and fun subjects than science, technology, engineering and mathematics!

Anyway, just about everyone carries a smartphone in their pocket now and that realisation has led to a couple of totally ingenious low-cost attachments that turn a smartphone into a high-powered microscope. However, as brilliant as they are, they both essentially need access to a 3D printer, while one also requires a silicon polymer called polydimethylsiloxane or PDMS.

But for many Android device owners, there's a third option we've been playing around with this month. A couple of years ago, we purchased a small $35 USB microscope off eBay claiming between 20x and 800x-magnification from its manual-zoom lens. We've used it on a number of occasions in capturing the sub-pixel patterns of smartphone and tablet LCD and OLED display panels. It came with a disc of Windows software and worked surprisingly well.



Lollipop/5.0 will recognise the USB device and ask permission to use it.



You need a USB-OTG cable to connect the USB microscope to most phones.

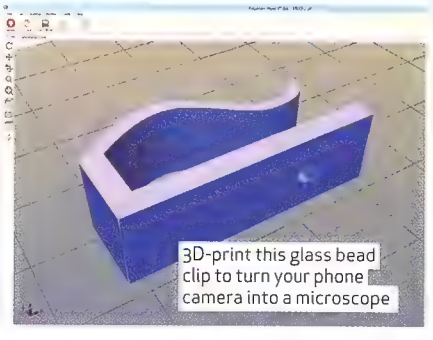
My feature in last month's issue of *APC* on recycling your old Android hardware got me recycling some old favourite USB sound cards, allowing me to upgrade the basic on-board audio recording capabilities of my Android devices into something approaching a digital audio workstation.

Now, we've found a way to add that USB microscope to Android devices. The process isn't bulletproof (we've not had 100% success with every Android device tested yet), but it doesn't need a 3D printer or require attaching anything more to your phone or tablet than a USB plug.

UVC DRIVERS

You're probably familiar with USB Mass Storage and USB Audio Class device drivers – they're the drivers built into most modern OSs that enable you to plug a USB flash drive or cheap audio DAC straight into your computer without having to worry about a driver download. What you may not know is that there's a similar thing for cameras, known as UVC or USB Video Class, commonly used with webcams.

UVC drivers have appeared in Windows since XP and in Linux since kernel release 2.6.26. However, while Android is based on Linux, support for USB devices hasn't been and still isn't universal. The Google-powered OS

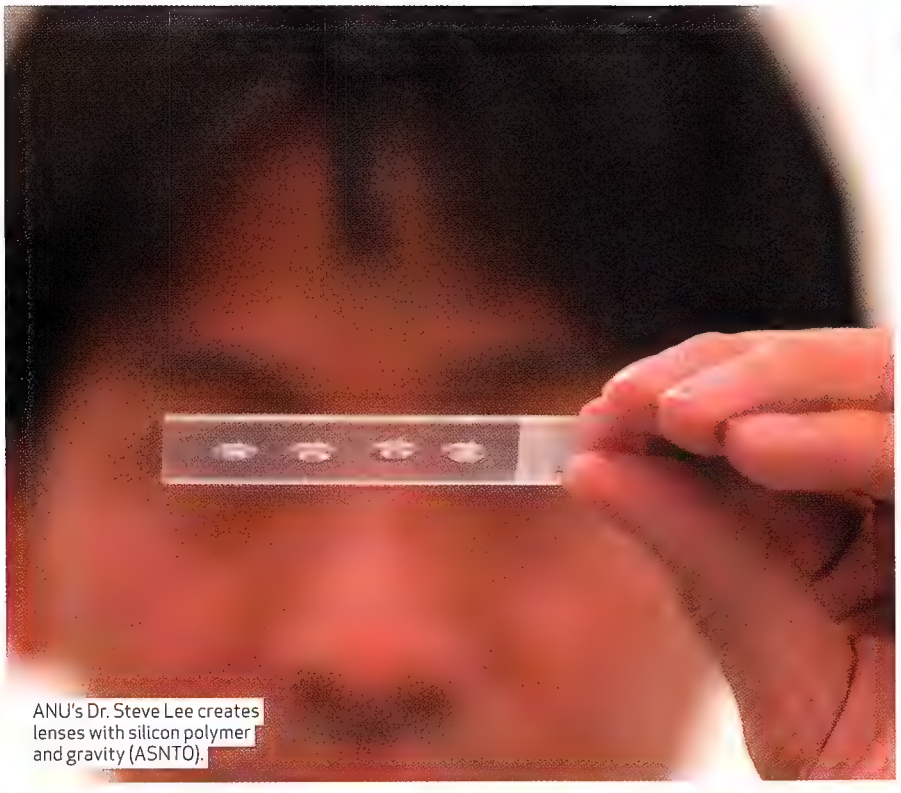


3D-print this glass bead clip to turn your phone camera into a microscope

picked up USB Mass Storage support in Ice Cream Sandwich/4.0, but the search giant has only just now begun adding USB Audio Class device support with the release of Lollipop/5.0.

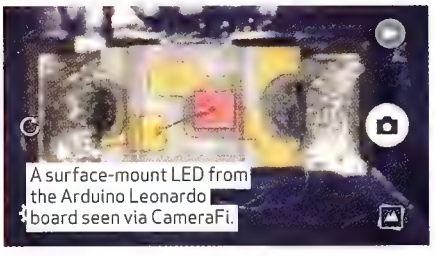
A quick look online at various forums revealed we certainly aren't the first to think of connecting a USB microscope into an Android device. What was surprising, however, were the number of responses that suggested it couldn't be done. Not without reason, I guess – apart from Android's general lack of USB device support, the lack of specific Android device drivers for many of these USB scopes would have you think there wasn't much hope.

But as we found out last month looking into USB sound card support, it's not all doom and gloom.

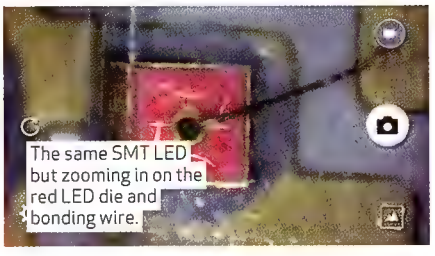


ANU's Dr. Steve Lee creates lenses with silicon polymer and gravity (ASNTO).

A tiny 220-ohm four-way surface-mount resistor from the Leonardo board.



A surface-mount LED from the Arduino Leonardo board seen via CameraFi.



The same SMT LED but zooming in on the red LED die and bonding wire.

"Everyone carries a smartphone in their pocket now and that has led to a couple of totally ingenious low-cost attachments."

WHAT YOU NEED

As we said, we haven't succeeded in getting our USB scope running with every Android device we've tested, but we've had at least two devices working perfectly with a number of free apps available on Google Play. Here's what we've used:

- 800X (VGA-resolution) USB microscope ($35, eBay, 2012)
- USB-OTG cable
- CameraFi (Google Play, free)
- DashCam (by Droidperception, Google Play, free)
- UsbWebCamera (Google Play, free)
- Android device with at least ICS/4.0 OS*

WHAT WORKS, WHAT DOESN'T

Now, the reason for that asterisk – we've had terrific success using the scope on a Galaxy S3 smartphone with custom Lollipop/5.0.2 ROM via the CameraFi app. We've also had it running nicely on an un-rooted Acer Iconia Tab A200 tablet with a stock ICS/4.0.4 ROM using DashCam. A few months ago, I picked up a budget quad-core 7-inch tablet with KitKat/4.4.2 and Wi-Fi from the local Coles Supermarket for $30. But unfortunately, while the tablet found the USB camera, no amount of cajoling or my best Basil Fawlty impersonations would have it pick up the video stream.

We also failed to get it working with a Galaxy S2 phone running a stock Jelly Bean/4.1.2 ROM as the ROM doesn't include the necessary UVC driver support.

As for the USB microscope itself, we purchased ours back in late-2012 off eBay for around $35. Today, similar models now sell on eBay for as little as US$15, including shipping. We can't guarantee which models will work with your Android devices, although we suspect most sellers are selling the same unit. Still, they also come with PC software, so you should be able to use it, one way or another.

All of the apps we've tried are free from Google Play. The Iconia Tab A200 is one of the few Android tablets to feature a full-size USB2.0 host port, so for other devices, you'll need a USB-OTG adapter cable, which you can pick up from most electrical retailers for under $10.

USING CAMERAFI

CameraFi is the most polished of the USB camera apps we've seen and reasonably straightforward to use. It'll capture stills and video, up to the resolution of your USB microscope's camera.

Setting up the hardware, the first step is to plug the USB-OTG cable into your Android device, then plug the scope's USB plug into the USB-OTG cable (or just use the full-size USB2.0 host port on an Iconia Tab A200). Launch CameraFi and once passed the splash screen, you'll either get the setup screen if the app can't find the camera, or you'll go straight to the video frame. Make sure the ring LEDs are set to full brightness and you train the scope onto something, just to test.

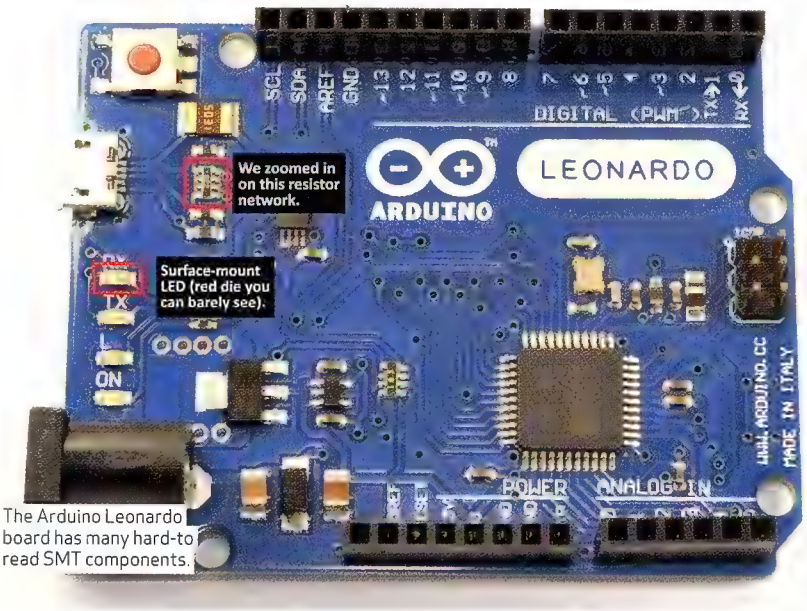
If there's no image, or you get the 'no uvc camera found' message, try either of the other two apps, DashCam or UsbWebCamera. We had no success with CameraFi on our Iconia Tab A200 with the same USB scope, but DashCam picked it up straight-away.

The most annoying thing with CameraFi is its penchant for including a logo-watermark on every still image you capture via the app. Interestingly, there are no watermarks when capturing video. The alternative is to simply use Android's built-in screen capture feature for stills.

Our test scope offered a basic 640 x 480-pixel (VGA) resolution at 30fps and the Galaxy S3 smartphone had no trouble keeping up with the incoming video stream.

POWERING THE SCOPE

The Iconia Tab A200 tablet is the ideal device to run a USB microscope with – not just for its USB2.0 Type-A host port, but because it has a separate



The Arduino Leonardo board has many hard-to read SMT components.

You'll need a good USB-OTG cable to connect the scope to most devices.

power input. Using a USB-OTG cable means power for the scope and its LEDs has to come from your Android device's battery. To gauge the power drain, we measured the current draw of the scope through the USB-OTG port at 80-milliamps (80mA), ring LEDs off, and 130mA with them at full brightness. When you start capturing video from the scope camera, that drain will go up further. It all contributes to a reduction of battery life, so it's just something to keep in mind during use.

We pointed our scope at a small Arduino Leonardo microcontroller board with tiny surface-mount components – not only could we see the make-up of the tiny surface-mount LEDs, we were able to zoom right in onto the red die and reflector plate. And it's pretty good at seeing the subpixel pattern of a device's LCD panel as well.

As we said, we can't guarantee every USB microscope will work perfectly with every Android device – it will depend on whether UVC drivers have been included in the device's OS. However, it's certainly not as impossible as many people seem to think.

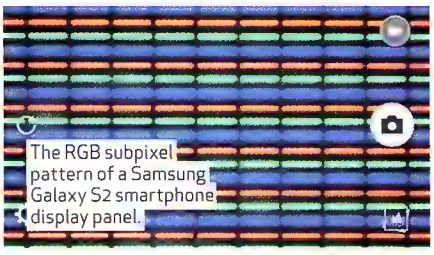
3D PRINTER & BOROSILICATE GLASS

If you'd prefer an alternative that's lower in cost (kind of) and uses your Android's built-in camera, a team from Pacific Northwest National Laboratory (PNNL) in the US came up with a really clever solution, combining 3D printing with small glass beads (**tinyurl.com/mm2eohl**). The technique relies on the fact that light passing through a glass sphere is refracted and magnified in such a way that when placed hard up against the camera lens, the power of magnification is inversely proportional to the diameter of the glass bead. Or in other words, the smaller the bead, the greater the magnification. PNNL might get the kudos for creating the 3D printed phone camera attachment, but the glass bead microscopy thing dates back to the 17th Century and Aton van Leeuwenhoek, often considered the Father of Microbiology for his work in spherical lenses and peering into life in miniature.

PNNL's clever idea was to hold the glass bead up against the phone's camera lens using a 3D-printed modified drawing board clip. With a 3mm glass bead, PNNL measured a 100x magnification, 300x with a 1mm bead and an impressive 1000x using a tiny 0.3mm bead. You can download the STL print files for each of the 3D printed clip designs from the PNNL web site above.

Getting hold of the glass beads, however, may prove a little more difficult. PNNL used a local US bead supplier, so we searched for a local Australian source. But, apart from the sea of retailers offering jewellery beads, we came up blank (you can't use jewellery beads as the thread hole through the centre kind of ruins the effect).

VGA-camera USB microscopes like this now sell on eBay for under $20.



The RGB subpixel pattern of a Samsung Galaxy S2 smartphone display panel.

What you're looking for, initially, are 3mm round/spherical glass beads, but they can go by various names, including borosilicate glass, flint glass and soda-lime glass beads. Do an eBay search for '3mm soda lime' and you'll find a few sellers in China who'll do you a small 60-gram packet of soda-lime glass beads for as little as US$5, including shipping (again, make sure they're not jewellery beads). Most of these glass beads are industrial rather than optic-grade, meaning you might find some with imperfections that cloud up the image. But even in a 60-gram pack, you should have a couple of dozen beads from which to find the perfect one.

The PNNL web site offers STL print files for 3mm, 1mm and 0.3mm bead clips, but they recommend you start with 3mm beads to get your bearings.

DROPLET LENSES

However, glass beads aren't the only solution. Dr. Steve Lee, researcher at the Australian National University's School of Engineering, came up with a novel approach that kind-of recreates Leeuwenhoek's idea, but with a more modern twist. Instead of using soda-lime glass, Lee created a lens shaped like a droplet using polydimethylsiloxane (PDMS), the stuff contact lenses are made from (**tinyurl.com/pmp6hey**). According to the World Health Organisation, it's also allowed in tiny amounts in a range of foods, including beer, vegetable oils, even frozen vegies, as an anti-caking agent (**tinyurl.com/m6mptas**).

We used a Galaxy S3 with Lollipop/5.0 and the CameraFi app to capture images.

> "It's pretty good at seeing the subpixel pattern of a device's LCD panel as well"

You can buy 400g of 3mm soda lime beads on eBay for around $25.

Back to droplet lenses, Dr. Lee picked up the 2014 ANSTO Eureka Prize for his discovery, which is brilliant in its simplicity. He started by placing several 'base' drops of PDMS on a glass microscope slide and cured them in an oven at 70°C for about 15 minutes. He then added additional droplets and turned the slide upside down. As Dr. Lee says, 'gravity does all the work' creating the large droplets that form perfect lenses. By adding more droplets, allowing gravity to extend the droplet shape further and curing it in the oven along the way, you can create your own custom focal length and magnification power.

According to ANU, Dr. Lee and his team managed up to 160x magnification from their droplet lens (**www.ncbi.nlm.nih.gov/pmc/articles/PMC4026886/**).

While the 'Biomedical Opticals Express' research paper mentions the PDMS polymer Dr. Lee used (Sylgard 184 Silicone Elastomer from US chemical giant Dow Corning), it'd be interesting to see if it can be replicated with similar-viscosity retail PDMS silicone oils available in Australia.

As for how hard it is to make your own droplet lenses? Dr. Lee believes "it's very easy to do — in fact, I think anyone at home could do it".

TAKE YOUR PICK

Smartphones offer functionality and possibilities well beyond phone calls and Facebook. As we saw last month, even retired Android devices already have the right tech on-board to create audio signal generators for sound engineers and students. Now, you've got at least three different ways to turn your Android smartphone or tablet into a pretty decent microscope. Who says science isn't fun?

Network your Arduino

Connecting your Arduino to your home network is easy. Darren Yates shows you how to make a simple web server.

The basic Arduino Uno board (or its Arduino Duemilanove predecessor) is incredibly versatile, thanks to the double row of pin headers on the long edges commonly known as the 'shield header'. We've already looked at how to plug in an LCD display and a motor drive shield, but if you're interested in making 'Internet of Things' (IoT) projects, you can even plug in an Ethernet shield. Because the Arduino Uno's microcontroller chip, the Atmel ATMEGA328P, clocks along at a sedate 16MHz and only delivers 8-bit processing, you are limited to relatively low transmit speeds, typically less than 500KB per second. But for reading sensors and delivering remote information, it's a great way to hook up your Arduino board and learn about networking at the same time.

W5100 ETHERNET SHIELD

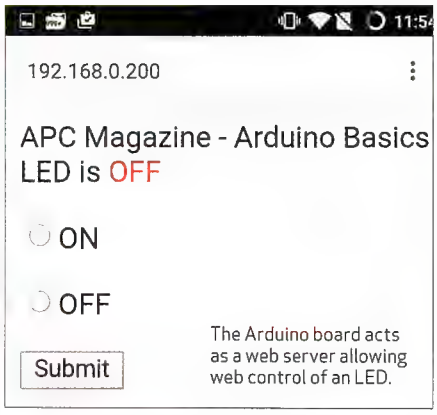
The W5100 Ethernet Shield uses a low-cost Wiznet W5100 controller chip that delivers a standard Ethernet port, plus the bonus of MicroSD card storage on the other end. This enables you to not only transmit data but also store it. The card reader handles up to 32GB MicroSD cards and most relevant Arduino code libraries available will handle FAT32 filesystems comfortably, giving you file sizes up to 4GB.

You'll find the shield online via eBay sellers starting from around $8.50.

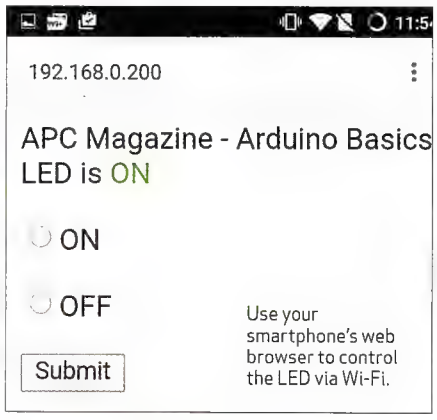
The new Arduino 1.6.4 IDE gives you details on remaining available RAM.

SERIAL PERIPHERAL INTERFACE

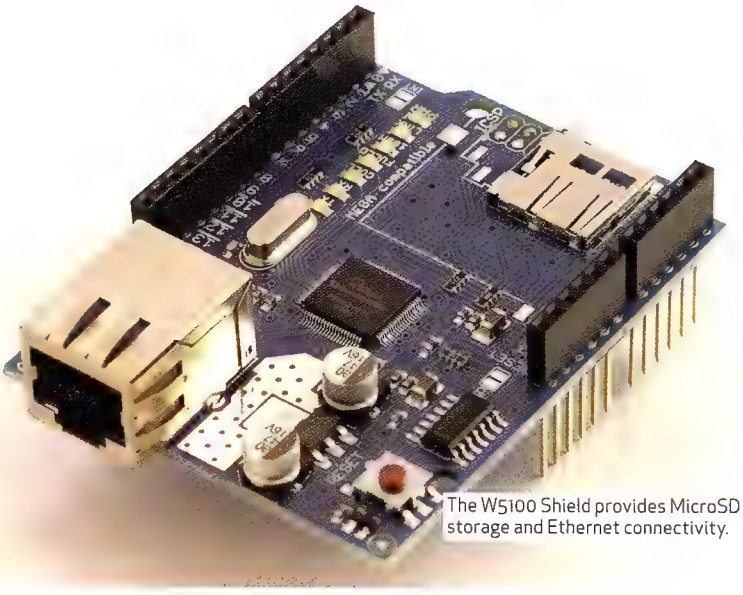
The Arduino Uno board has 20 digital I/O pins you can 'bit bang' (send high or low) to transmit data, but arguably it's most useful connection port is the Serial Peripheral Interface or SPI. Many electronic devices support SPI connection and here, the interface has a general speed of 4MHz, which isn't bad given the ATMEGA328P only clocks at 16MHz. It's also the interface used by the W5100 Ethernet Shield, which is why it has the six-pin header on the underside of the board. Those six pins form the Arduino's main SPI connection (although there's a secondary option on pins D11, D12 and D13, **www.arduino.cc/en/Reference/SPI**).



The Arduino board acts as a web server allowing web control of an LED.



Use your smartphone's web browser to control the LED via Wi-Fi.



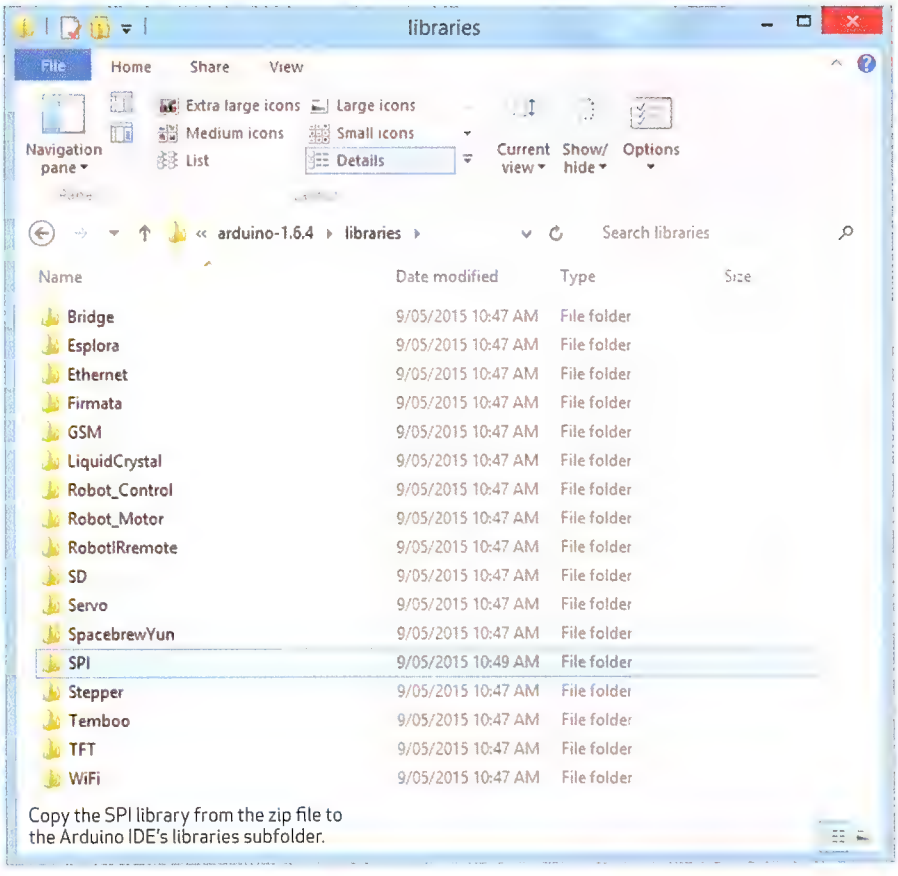
The W5100 Shield provides MicroSD storage and Ethernet connectivity.

ETHERNET LIBRARY

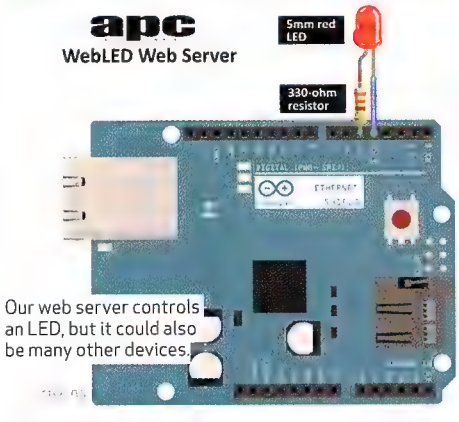
As with most external shields, the Ethernet shield needs two code libraries in order to provide the programming instructions to make your shield do something – in this case, the Ethernet library and the SPI library. Our project this month is a very simple web server that lets you switch on and off an LED connected to the Arduino. You'll find the source code, plus the SPI code library on our web site at **www.apcmag.com/magstuff**. Download the zip file, unzip it and copy the contents of the /libraries folder to the /libraries folder of your Arduino IDE. The Ethernet library comes with the Arduino IDE – grab the latest v1.6.4 release from **arduino.cc/download**.

HOW THE SOURCE CODE WORKS

The LED in our project connects in series with a 330-ohm resistor between I/O pins D5 and D4 (acting as ground) – not terribly interesting, but enough to have our web server do something that shows how control via a web server can work.



Copy the SPI library from the zip file to the Arduino IDE's libraries subfolder.



Our web server controls an LED, but it could also be many other devices.

Load the WebLED source code into the Arduino IDE and after the comments and '#include" statements that load up the code libraries, we then get to the initialization code.

An Ethernet port needs two pieces of identifying info – a Media Access Control (MAC) address and an IP address. The MAC address identifies your Ethernet shield, while the IP address identifies your location on the network – think of it as your name and address on your snail mail.

It means the first thing the source code requires is to set these MAC and IP addresses – you can make them up, but they must be valid addresses. We've chosen the default MAC address used for Ethernet shield and since its 48-bits long, it's unlikely to run into anything else with that address on your network – this sits in the mac[] byte array.

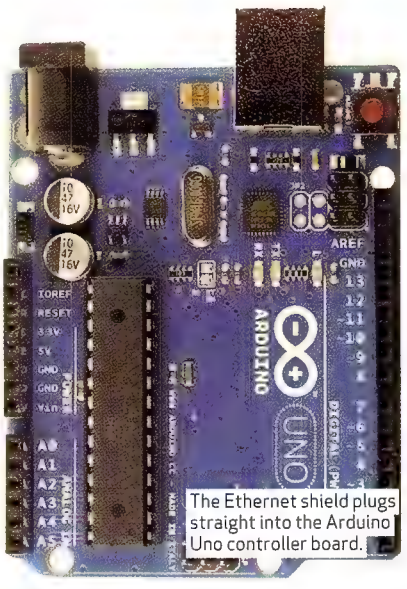
The IP address, however, has to fit your local network and uses the standard 32-bit IPv4 addressing standard, where home networks usually start on '192.168'. We've selected '192.168.0.200' here – again, it's unlikely you'll have anything else on that particular address, but just check – if you're router is set to 192.168.1.xxx, you'll need to change your IPAddress code appropriately (e.g. 192.168.1.200).

In the setup() method, we declare I/O pins D4 and D5 as outputs and start the Ethernet connection with the 'begin' statement and the MAC and IP addresses as parameters. Next, we launch the server with another 'begin' statement.

MAIN LOOP

Once you have the project built, powered up and connected to your router, head to your PC, smartphone or tablet, fire up a web browser and enter the address you chose for the IPAddress variable ('192.168.0.200' in our example). What happens now is the web browser sends out an HTTP request for data. Your router recognises that address as on the local network (your home network) and hits the Arduino board.

The main loop of our source code at this point, is waiting for a client. When a client connects, the code then sends back a very basic HTTP webpage using the 'client.println' statements. Now



The Ethernet shield plugs straight into the Arduino Uno controller board.

here's the clever bit – remember that we're using the Arduino to control the LED over the web. First thing it does is check the digital pin D5 to see if the LED is on (high) or not (low) using the 'if (digitalRead(5))' command. If D5 is high (LED is on), it sends data to the web browser that the LED is on and vice versa.

Next, it then creates a simple HTTP form with two radio buttons and essentially waits for the user to make a choice. Once the choice is made and the Submit button pressed, HTTP code comes back from the user's web browser into the Ethernet buffer. We check that buffer to see if the return code includes a '/?LED=on' or '/?LED=off' entry and write the D5 pin output appropriately. Why is this clever? Because the Arduino is able to make the leap between web pages and discrete electronics on its own – that's seriously cool stuff.

Finally, the 'client.stop()' code ensures that as soon as any interaction between the server and web client is complete, we let go of that connection to ensure we play good 'network neighbours' and don't hog the network.

INTERNET OF THINGS

Sure, we're making baby steps here, but this can be the start of building your own Internet of Things projects. It's also why the whole IoT concept is so popular – the ability to control devices over the web (especially when that control comes from a smartphone or tablet) opens up a world of opportunities only limited by your imagination.

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Everything you need to get started with the exciting new world of Arduino. Kit includes "Eleven" board, servo motor, lights, switches, sensors, breadboard and more. Complete with instructions, software examples. No soldering required.

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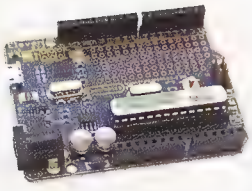
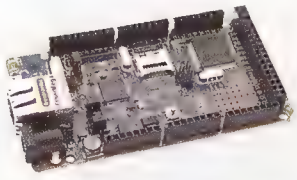
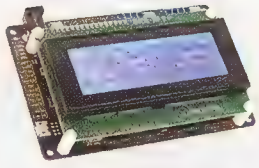
ARDUINO COMPATIBLE BOARDS

*See website for full specification

	ELEVEN XC-4210 $39.95 Improved version of Arduino Uno with better performance and lower cost. Its stackable design makes adding expansion shields easy.	ETHERMEGA XC-4256 $119.00 The ultimate network-connected board. With onboard Ethernet, a USB-serial converter, Power-Over-Ethernet support and more.	STEPDUINO XC-4249 $149.00 A self-contained board with onboard stepper motor drivers, servo interface, and 20x4 character LCD.
Microcontroller	ATmega328	Atmel ATmega2560	ATmega328P
Clock	16MHz	16 MHz	16 MHz
Flash Memory	32 KB	256 KB	32 KB
SRAM	2 KB	8 KB	2 KB
Digital I/O Pins	14	54	14
Analog Pins	6	16	8







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Add colour to your entertainment area. Infrared remote control for setting colour and amazing effects that emulate shooting stars, flowing water and more. Adhesive backing.

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- Individual LED status display on every output channel

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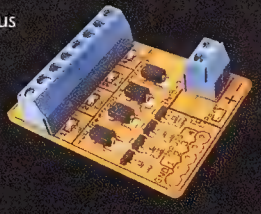

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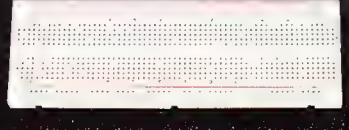

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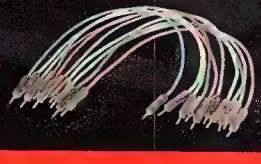

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Java Part 10 – Object-oriented programming

It's the buzz-phrase driving much of professional coding today. Darren Yates explains the basics of Object-Oriented Programming.

The thing we've been most determined to be above all in this Learn to Code Masterclass is practical, which is why we've been coding right from the get-go. You simply can't learn to code sitting on the sidelines – you have to get in there and get your hands dirty. But if you're serious about wanting to code properly, even professionally at some point, you also need some theory under your belt – and it's time we looked at some. If there's one programming paradigm that permeates professional coding these days, its Object-Oriented Programming, or OOP for short. Most modern programming languages from Java to C# support OOP, even Python. But while it isn't universally adored, OOP is a technique that can change the way you program, getting you to think in a more organised way about how you code a solution to a programming problem.

THINKING IN OBJECTS

I've lost track of the number of desktop PCs I've built over 20 years or so. If you've been reading *APC* even for just a short time, you'll know a PC isn't just a single entity – it's made up of various components. Every PC starts with a case, into which you fit a motherboard, which, in turn, houses a CPU, some RAM and a storage drive. Just take the CPU, for instance – there are multiple options you can build a desktop PC around, whether you choose Intel or AMD. In either case, each CPU can be seen to have the same basic attributes – clock speed, number of cores, socket

All CPUs have basic attributes we can turn into a 'Processor' template or class.

Processor Class

```
package processorlist;

public class Processor {
    private String name;
    private String socket;
    private int cores;
    private int clock;
    private int cacheInKb;
    private double scale;

    public Processor() {}

    public Processor(String type, String sockettype, int numCores, int speed, int cache) {
        name = type;
        socket = sockettype;
        cores = numCores;
        clock = speed;
        cacheInKb = cache;
    }

    public String getName() { return name; }
    public void setName(String cputype) { name = cputype; }

    public int getMHz() { return clock; }
    public void setMHz(int speed) { clock = speed; }

    public int getCache() { return cacheInKb; }
    public void setCache(int kbCache) { cacheInKb = kbCache; }

    public int getCores() { return cores; }
    public void setCores(int numOfCores) { cacheInKb = numOfCores; }

    public String getSocket() { return socket; }
    public void setSocket(String sockettype) { socket = sockettype; }

    // ridiculously crude performance formula based on chiptype, clock speed and cache
    public double getPerformance() {
        if (name.indexOf("i3") > 0 ) { scale = 1.0; }
        else if (name.indexOf("i5") > 0 ) { scale = 1.25; }
        else if (name.indexOf("i7") > 0 ) { scale = 1.4; }
        else if (name.indexOf("FX") > 0 ) { scale = 1.0; }
        return scale * (clock / 1000) * (Math.sqrt(cacheInKb / 20000.0));
    }
}
```

Class declaration

In-class variables

No-argument constructor

Constructor

getters and setters for class attributes

class method

Classes in OOP act as templates for stamping out objects that simplify coding.

Constructors aren't new!

Creating a JLabel object for a Graphical UI

Class identifier | object reference name

```
JLabel labelQuestion =
    new JLabel("TablesTest", JLabel.CENTER);
```

'new' operator | Class type and parameters

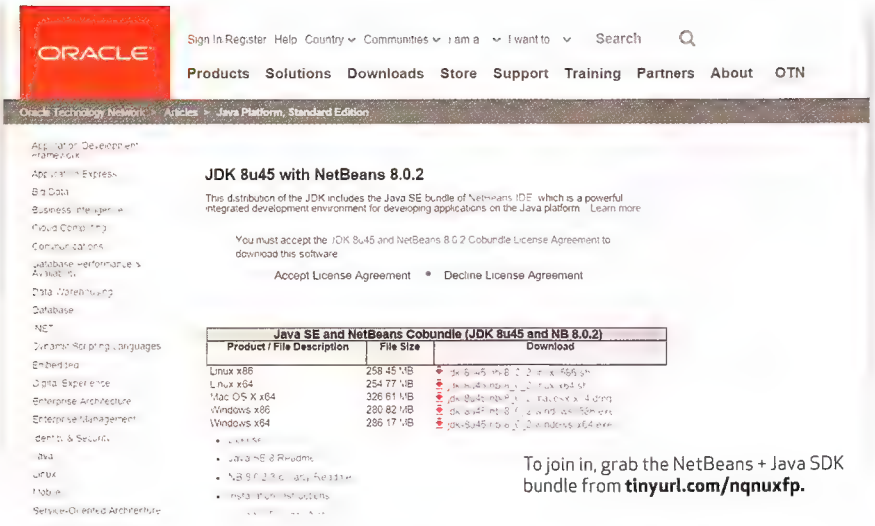
Creating a Processor object in our new class

Class identifier | object reference name

```
Processor intelCorei3 =
    new Processor("Intel Core i3-4170", "LGA1150", 2, 3700, 3072);
```

'new' operator | Class type and parameters

We've created a Processor constructor, but we're always using constructors.



To join in, grab the NetBeans + Java SDK bundle from **tinyurl.com/nqnuxfp.**

Indexed vs non-indexed for-loops

For-loop using an index variable

```
for (int index = 0; index < listOfCPUs.size(); index++) {
    System.out.println("Processor name   : " + listOfCPUs.get(index).getName());
    System.out.println("Processor clock  : " + listOfCPUs.get(index).getMHz());
    System.out.println("Number of cores  : " + listOfCPUs.get(index).getCores());
    System.out.println("CPU performance  : " + listOfCPUs.get(index).getPerformance());
}
```

For-loop using sequential object processing

```
for (Processor cpu: listOfCPUs) {
            System.out.println("Processor name   : " + cpu.getName());
            System.out.println("Processor clock  : " + cpu.getMHz());
            System.out.println("Number of cores  : " + cpu.getCores());
            System.out.println("CPU performance  : " + cpu.getPerforma
        }
```

Objects allow you to use a more compact 'for-each' looping mechanism.

"If you're serious about wanting to code properly, or professionally at some point, you need some theory under your belt"

type and an amount of cache.

CPUs are examples of real-world objects and in the world of OOP, objects of the same basic type can be represented by a template or 'class' that describes their attributes plus their functions or actions.

We've already covered the basic attributes of a CPU, but now imagine that we could work out a CPU's performance using a mathematical formula based on those parameters. We could predict (although not very well) how it would perform – in terms of OOP coding, we could consider this a function or action.

In fact, what we've just done (however crudely) could be described as 'object-oriented modelling/analysis', looking at an object or problem, working out its key features, how it works and what we need of it to include in our program. We don't have space to cover it this month, but its part of a much larger concept called the 'Software Development Life Cycle'.

However, getting back to OOP, we now have a basic template for a processor – from that template, we can create a Java class and from that class, we can create Processor objects that you'll hopefully see greatly simplify our program coding.

PROCESSOR CLASS

Download this month's project source code from **www.apcmag.com/magstuff**, unzip it and file/import the 'ProcessorList.zip' file straight into the NetBeans Java IDE (get the IDE from **tinyurl.com/nqnuxfp**). You'll see two files – one called processor.java and the other, processorlist.java. Take a look at processor.java to begin with and it'll probably look a bit weird at first, as though it's not a real Java program. In a way, it's not – at least not like other Java code we've made so far. On its own, processor.java has no outward function, no GUI or console output. But what it does is define and implement our template for creating 'processor' objects.

If you look at the Processor class code diagram, the Class declaration begins with a number of private class variables. The private keyword is called a 'visibility modifier' and it sets how visible a variable or method is to other classes within the app. Here, the private modifier says these variables – name, socket, cores, clock, cacheInKb and scale – are private variables not to be visible outside of this class. If you try to reference them in the processorlist.java code for example, you'll get a syntax error because of this private modifier.

[illegible]

To use the class template and create a processor object, the class also includes two special methods called constructors. The first is called a 'no-arguments' constructor because it takes in no parameters or arguments – note the empty brackets (). It simply generates an empty processor object.

However, the second one creates a processor object and populates it with supplied parameters in the one step. You can see that it takes in five arguments – type, sockettype, numCores, speed and cache – and assigns those values to their respective private class variables.

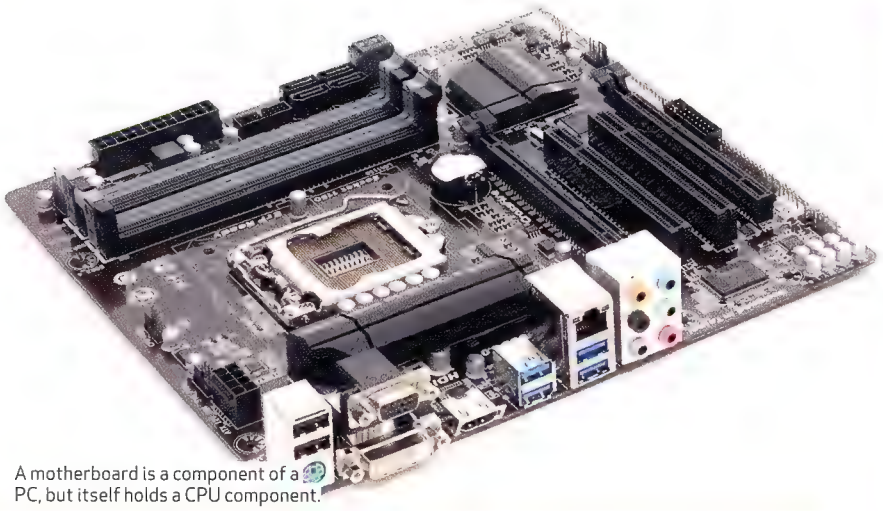
Note that both of these constructors use the public modifier – that's because we want these constructors available to other classes to make processor objects.

SETTERS AND GETTERS

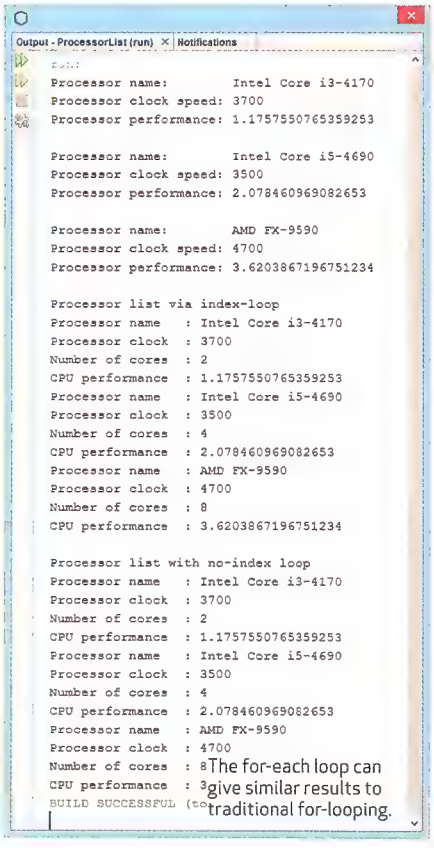
But if the class variables are all private, how can we access them from outside of this class – and why have private class variables in the first place? If you're asking yourself these questions, you're on the right track!

When you go into a supermarket, you pick up your groceries off the store shelves – those shelves are the public storage arrays the supermarket makes available. However, those groceries first arrive in the store delivery dock in huge cartons. These huge cartons are the equivalent to our private class variables – just as a supermarket doesn't want consumers ferretting through its cartons out the back, we don't want apps directly accessing these private variables. Not only could they be hacked or modified, direct-access to private variables could muck up how the class works.

So to fix that, we supply a series of public 'getter' and 'setter' methods in the class, which provide the public-facing store shelves for obtaining and setting each parameter. They're the



A motherboard is a component of a PC, but itself holds a CPU component.



The for-each loop can give similar results to traditional for-looping.

> "It'll help you not only create cleaner code, but be able to handle much, much larger projects."

other side of the no-args constructor – you might not always know every parameter at the time you want to construct an object, in which case, you use the no-args constructor and set each class parameter later using the appropriate setter method.

DATA ENCAPSULATION

This idea of protecting private data is called 'data field encapsulation' – we're encasing these private variables in public-facing methods, so that no-one can mess with their functionality inside the class. For example, notice that we haven't yet talked about the last private class variable 'scale' – it's not in the constructor and it has no getter or setter methods. So how do other classes get access to it? Simple – they don't. The scale variable is our own private variable used in the one extra method this class has: getPerformance().

The value stored in this variable is derived from the other parameters. We identify what type of CPU the object is from the name string and set the scale variable accordingly. For example, if the CPU object is set as a 'Core i3', the scale variable is set to '1.0', if it's a Core i5, it becomes 1.25 and for an AMD FX-series CPU, we set it to 1.0.

These numbers mean absolutely nothing outside of this class (and they don't mean much more inside it, truth be known), but even more, we don't want these values seen outside of this class – nor do we want them modified. To the outside world, a processor has a clock speed, socket type, number of cores and cache, but not a scale. Data field encapsulation not only protects internal class variables from being modded, but a side benefit is that it enables us the freedom to add in other class-only variables that won't be seen from the outside – just like the supermarket delivery dock.

USING THE CLASS

Now that we have this Processor class, how do we use it? To make a class easier to understand more quickly, it's common to generate a 'class diagram' using the Unified Modelling Language (UML), with the class name at the top, followed by the class variables or data fields listed by 'name: type' and finished off with the constructors and class methods. The '-' sign at the start of a variable or method indicates a private modifier, '+' signs a public modifier.

Now for the implementation – take a look at the super-simple ProcessorList.java source code in your IDE. Hopefully, you see only a handful of code lines, but also no references to our private Processor class variables. Instead, we create Processor objects called 'intelCorei3' and 'amdfx'. In fact, those initial three code lines tell us plenty – for starters, we can accommodate both Intel and AMD processors with the same Processor class.

We've also been able to create three processor objects, name them and populate their parameters, all in three lines of code. Yes, there's a heap of code behind this, but we've hived that off into a separate class, leaving our code here very simple and easy to read.

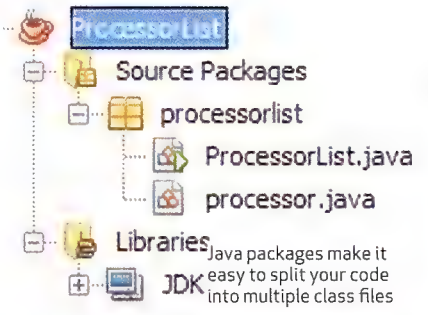
And finally, look at the way the Processor constructor works – the class identifier, followed by the object name, the assign (=) sign, the new statement, indicating we're creating a new object, ending with the Processor class and the parameters we want to use. Compare that to some of our other projects and hopefully, you can see the similarity – this is, in fact, how most Java instructions are developed. For example, a JLabel is a Java class for creating user interface text labels that comes with a number of different constructors. You can think of what we've done here as creating a new Java command called 'Processor'.

If you haven't quite got it nailed yet, re-read this and look through the code as it's a fundamental part of object-oriented programming. Once you get it under your belt, however, it'll help you not only create cleaner code, but be able to handle much, much larger projects.

LISTS OF OBJECTS

The concept of classes and objects becomes even more powerful when you start creating lists of objects. We've already had a good look at arrays and ArrayLists previously, but ArrayLists are just one part of a huge area called the 'Java Collections Framework', which includes a range of useful list types, including stacks and queues.

But here, we can start off simply by creating an ArrayList of processors we've called 'listOfCPUs'. The reason this is so important is that each

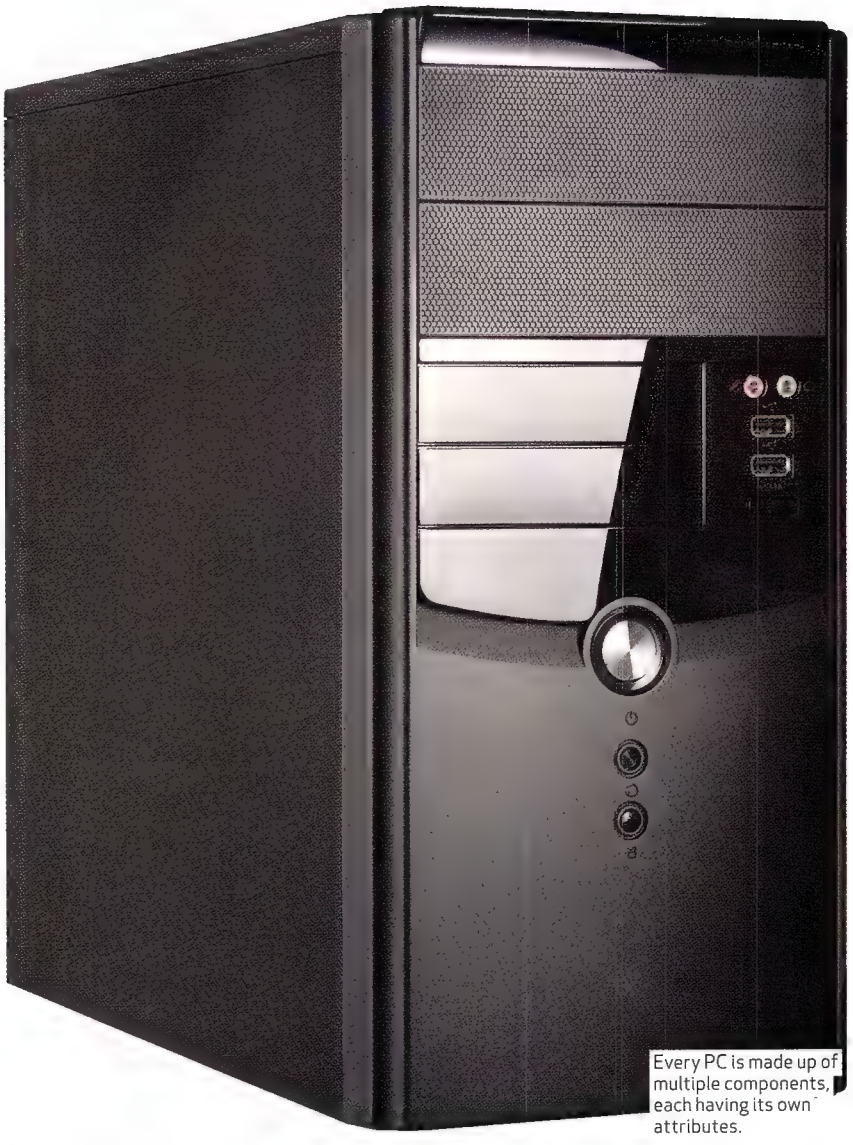


Java packages make it easy to split your code into multiple class files

Unified Modelling Language (UML) is typically used for class diagrams.

```
Processor
-name: string
-socket: string
-cores: int
-clock: int
-cacheInKb: int
-scale: double

+Processor()
+Processor(type: String, sockettype: String,
      numCores: int, speed: int, cache: int)
+getName(): String
+setName(cputype: String): void
+getMHz(): int
+setMHz(speed: int): void
+getCache(): int
+setCache(kbCache: int): void
+getCores(): int
+setCores(numOfCores: int): void
+getSocket(): String
+setSocket(sockettype: String): void
+getPerformance(): double
```



Every PC is made up of multiple components, each having its own attributes.

Processor object is a collection of parameters that apply to one CPU – and instead of having to manually create and manage each of those variables, we can use the Processor template to make objects of them quickly and easily – and make lists of them.

If you notice in the ProcessorList.java class, the initial output shows the object parameters obtained one at a time line-by-line. But with an ArrayList, you can loop through each object element and access the respective processor parameters on the run. Again, we've covered loops previously and we can loop our way through the ListArray of Processors using a basic for-loop. But there is an even simpler for-loop we haven't yet looked at called the 'for-each' loop – and it's perfect for this situation.

USING THE FOR-EACH LOOP

Look at the bottom of the ProcessorList.java code and you'll see the two for-loop forms – the first using a traditional index key to loop through the ArrayList via the get(index) method. The second one looks much simpler and loops via the objects themselves. Essentially, it says "for each Processor object in the Processor ArrayList, loop through the ArrayList". Here, the new 'cpu' object becomes the index key to loop through – you can see that in the following println statements, they all reference 'cpu' and the various parameter getters.

The for-each loop method is perfect for simple sequential-looping through a list in order. It's also ideal for when you're not particularly interested in the index or position of each element in the list. However, if you need to mix up the sequence order or you need to know or use the list element index, you go back to the traditional for-loop method.

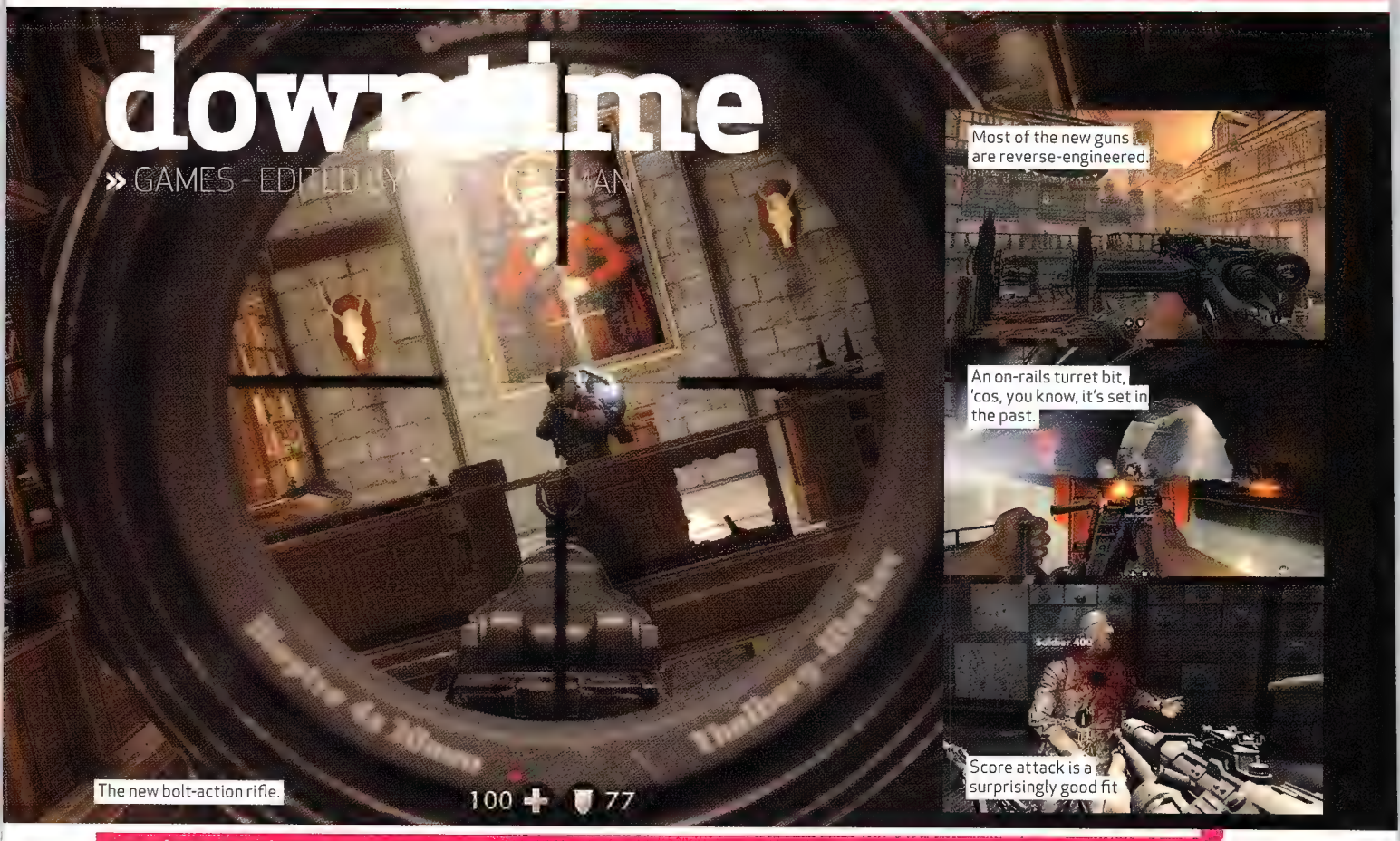
OOP DRAWBACKS?

OOP is a huge topic and we've just scratched the surface – we haven't yet touched on advanced concepts with odd-names like 'inheritance' and 'polymorphism'. But while OOP has become accepted practice in professional coding, it'd be fair to say it's not universally adored.

One example of the debate into OOP surrounds the common mantra that it's good for creating re-usable code (this is where 'inheritance' comes in), but it can also result in software that's less optimised, bulkier and slower than other solution-specific code.

It's an area of university research with growing emphasis on the concept of 'code optimisation'. Up until recently, Moore's Law has more or less given us a free ride in terms of performance gains, but as the amount of data spirals out of control, there are growing calls to address the issue of code optimisation and 'software bloat', making it a hot topic (**tinyurl.com/l3wsvz9**).

Still, OOP itself is only one of a number of programming paradigms or ways of thinking about coding, but its advantage is that it can help to simplify more complex problems.



Most of the new guns are reverse-engineered.

An on-rails turret bit, 'cos, you know, it's set in the past.

Score attack is a surprisingly good fit

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Wolfenstein: The Old Blood

Take a trip back in time, with some zombie Nazis.

A standalone prequel to last year's excellent *Wolfenstein: The New Order*, *Wolfenstein: The Old Blood* marks a return to the classic shooter's traditional ideas. It's a strange creative shift. *The New Order* was the game that proved it was possible to separate BJ Blazkowicz from Castle Wolfenstein and create something that still felt like a *Wolfenstein* game.

The Old Blood is far more familiar. It's set in 1946, involves both a return to and an escape from Castle Wolfenstein, plus plays out the consequences of Nazi occultism in a manner that will feel eerily familiar to anybody who's played *Return to Castle Wolfenstein* or Raven's 2009 reboot of the series. We'd been happy to see the series move away from gothic castles and gunfights in crypts. But, somehow, here we find ourselves again.

The good news is that MachineGames's unique sense of style has survived. The new Castle Wolfenstein is lovely to look at, a brutal marriage of Helm's Deep and *Half-Life 2's* Citadel.

That said, what was novel a year ago isn't necessarily novel now. Nothing in *The Old Blood* exceeds what was achieved in *The New Order*, and there are moments when the two are uncannily similar. There's even a bit where you're confronted by a senior female Nazi while carrying a wobbly tray of drinks. This is clearly deliberate, but now doesn't feel like the time for *Wolfenstein* to put out a greatest hits album. It's only just made the case for its continued relevance.

THERE WILL BE BLOOD

The Old Blood shares *The New Order's* impactful gunplay, but lacks its predecessor's pace and variety. A forced stealth section near the beginning lasts long enough to become irritating. What follows alternates between running gunfights, open-ended arena encounters and defence sequences with little escalation. Its high points are, as before, the moments when it lets you take on a room full of Nazis as loudly or quietly as you please. For every arena that makes the most of that freedom, there's another that is too small, too linear or too prescriptive to really deliver.

The introduction of the supernatural doesn't add anything you haven't already encountered in a hundred other shooters, including more than one prior *Wolfenstein* game. There are new weapons, but the majority of these are reverse-engineered versions of guns from *The New Order*, downgraded to match the '40s setting. The sawn-off shotgun is gratifying to use, at least, and a new grenade-launching pistol provides an impactful panic button.

The campaign took us around four-and-a-half hours to complete on the second-hardest setting, picking up about half of the game's hidden collectibles along the way.

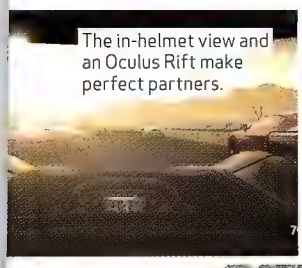
The Old Blood is a false start for *Wolfenstein's* life after *The New Order*, a creative step backwards that survives primarily because of the strong groundwork laid in the previous game. It will always be fun to fire these guns, and MachineGames's presentation is still ahead of the curve, but this isn't the game you should play if you want to explore those qualities. That game was released a year ago.

■ Chris Thursten

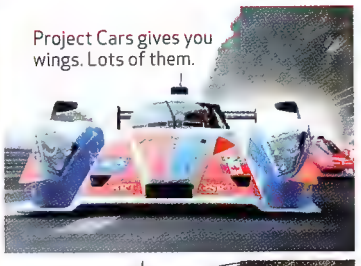
Verdict

Fun new score attack mode; still some satisfying gunplay; a few new weapons but it lacks variety.

★★★½


The in-helmet view and an Oculus Rift make perfect partners.

With a rear end like this, who needs Kim Kardashian?


Project Cars gives you wings. Lots of them.

Retro rides get an outing at California's Laguna Seca circuit.

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Project Cars

Some say it's the greatest racing game ever...

The rich realism and jaw-dropping visuals offered by modern *Gran Turismo* and *Forza* incarnations haven't quite been matched by a single PC title, but *Project Cars* aims to change that. This is a game that strives for total realism, both dynamically and visually.

Stare at the arse-end of one of the game's classic F1 cars and there's everything from individually modelled suspension wishbones to separate spark plug leads to drool over. Leaves rustle as you scream past. Raindrops glisten on gleaming body panels and grass sways in the breeze. There's also realistic crash damage, with deformable and detachable body parts, plus the ability to scratch that pristine paintwork and crack windows.

Track selection is almost uncompromising. Think of pretty much any bucket list race track and it'll probably be here. Those familiar with recent *Grid* titles will be at home in Career mode, where you choose between disciplines including open wheel or touring cars and progress through the ranks to reach an ultimate racing series.

Thankfully, all this polish hasn't been lavished on turds. Although the car list is nothing compared to *Gran Turismo* or *Forza*, it still features plenty of metal listed on the *Top Gear* lap times board. Drool at track day weapons like the Ariel Atom V8 and Caterham Superlight R500, through to hypercar exotica such as the McLaren P1, Pagani Huayra and W Motors Lykan Hypersport or classics like the retro BMW M3 and Mercedes 190E German touring cars.

Despite its bewildering array of vehicles, setups and force feedback options, the cars simply don't handle as realistically or consistently as in other simulators. If there's one constant in the physics department, it's that you don't feel quite as connected to the driving experience as you might want. This is partly down to those iffy handling characteristics, but also the lacklustre force feedback, which often fails to communicate basics like driving over a kerb and generally leaves many cars feeling somewhat numb.

But these are relatively minor gripes only worth picking on because *Project Cars* sticks its balls on the line and professes to be "the most authentic racing game on the planet". While it falls marginally short, this is still one of the most polished examples of the genre for PC gamers. ■ Ben Andrews

Verdict

Stunning visuals; beautifully modelled cars; great track lineup; mostly realistic handling.

★★★★

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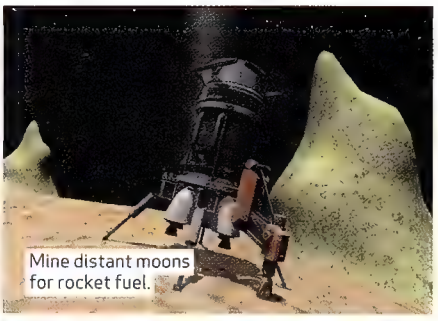
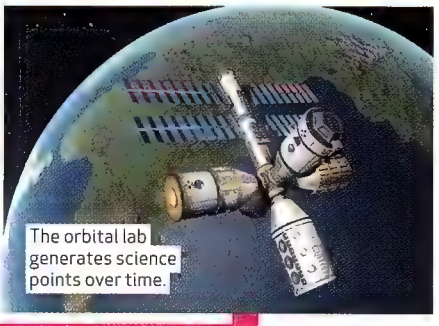
ASSASSINSCREED.UBI.COM

The most exciting thing to happen to *Assassin's Creed* in years is a 2D side-scroller. There, we said it. This sneaky spin-off crept out to little fanfare, but it's an absolute breath of fresh air for a franchise that needed one more than most. *Chronicles* is more of a true stealth game than you might have come to expect from the series. As Chinese assassin Shao Jun, your goal is to use your acrobatic skills, Animus powers, and a modest collection of gadgets to make your way as quietly as possible through some surprisingly expansive levels. One particularly clever new mechanic, though, is the guards' colour-changing vision cones. When the coast is clear, they're white, but if you're spotted they turn yellow, and the enemy will start to take an interest. That kind of clever feedback is key to a game like this and makes you feel like you've always got all the information you need to get the job done. The game's weak spot, unfortunately, is the story. Protagonist Shao is about as forgettable as they come, and her tale is one of generic revenge, MacGuffins, and broody monologues. It all feels very sparsely presented, too, with characters and events often poorly explained before being glossed over. It's also fantastic value, as between the main game and several New Game+ modes, you could easily spend over 20 hours stabbing, sneaking and synching through this refreshingly different *Creed*. ■ Robin Valentine





US$39.99 | PC | KERBALSPACEPROGRAM.COM

Kerbal Space Program

The little green astronauts achieve escape velocity.

After four years in open beta, there surely can't be anyone with even a passing interest in spaceflight who hasn't tried *Kerbal Space Program* yet. You drag and drop engines and fuel tanks to build a rocket, you strap strange little green dudes into the cockpit and you fire them into orbit. But if you tried *KSP* a few versions ago and weren't hooked, or exhausted everything the early sandbox game had to offer, is version 1.0 worth a second look?

The big change is that the aerodynamic simulation has been vastly improved, to match the already realistic orbital physics. Gone is the infeasibly thick 'soupmosphere' that required you to fly straight up for 10km and then pitch over 45° to fly into orbit. Not only is the air thinner close to the ground now, the density varies with temperature as well as altitude. Drag and lift properly account for how streamlined your rocket is and the sound barrier feels like a real barrier you have to punch through. Fly too fast, too low, and you'll experience compression heating.

To protect your delicate payloads from all this atmospheric buffeting, cargo bays and fairings have finally been added to the stock game. Fairings can be built to any shape in the editor and have a wonderful 'exploded view' feature that moves them out of the way so that you can continue to tweak the payload.

HARVEST TIME

The number of planets and moons in the solar system remains unchanged at 16 (though there are now asteroids in the orbit of Dres, as well as Kerbin) but there is a new reason to visit them: mining. Deposits of a nonspecific 'ore' are now randomly generated for each save on each body.

Career mode has been in development for a few versions and the 1.0 release hasn't made any ground-breaking changes. The algorithm that generates random commercial contracts has been tweaked to eliminate the daftest ones and there are new mission types that require you to ferry space tourists, and establish bases and space stations. Rescue contracts aren't just a lone kerbal floating in his spacesuit anymore, but can involve a damaged cockpit or piece of debris, or a kerbal crash landed on a distant planet.

For all the new parts and improved systems though, KSP 1.0 doesn't quite feel finished. You can still pull up the debug menu and tweak the 'drag cube multiplier' or the 'heat convection factor' — it's as if developer Squad still hasn't made up its mind about the best values. Orbital manoeuvres, particularly interplanetary transfers, are still much too fiddly to set up and adjust. There's nothing to tell you the thrust-to-weight ratio of your ship or its delta-V, neither when you are building your rocket, nor when you are in flight.

Career mode also lacks purpose. You take on contracts to earn money, but money isn't especially useful. The space centre building upgrades feel like they're just removing arbitrary restrictions. The tech tree gives you more parts as you unlock new nodes, but they aren't necessarily more advanced parts. You start with the smallest fuel tank, for example, and unlock larger ones later, rather than beginning with a heavy primitive tank in several sizes and unlocking lighter, stronger ones.

MORE TO COME

And yet, for all that, *KSP* has dominated my game playing since I first downloaded version 0.16, so it's obviously doing something right. The comparison is often made with *Minecraft* and it's not just a business model that they share. Both are games without a storyline, without a victory condition.

Everything new in 1.0 is an improvement and, for all the shortcomings that remain, you can download a mod to plug the gap.

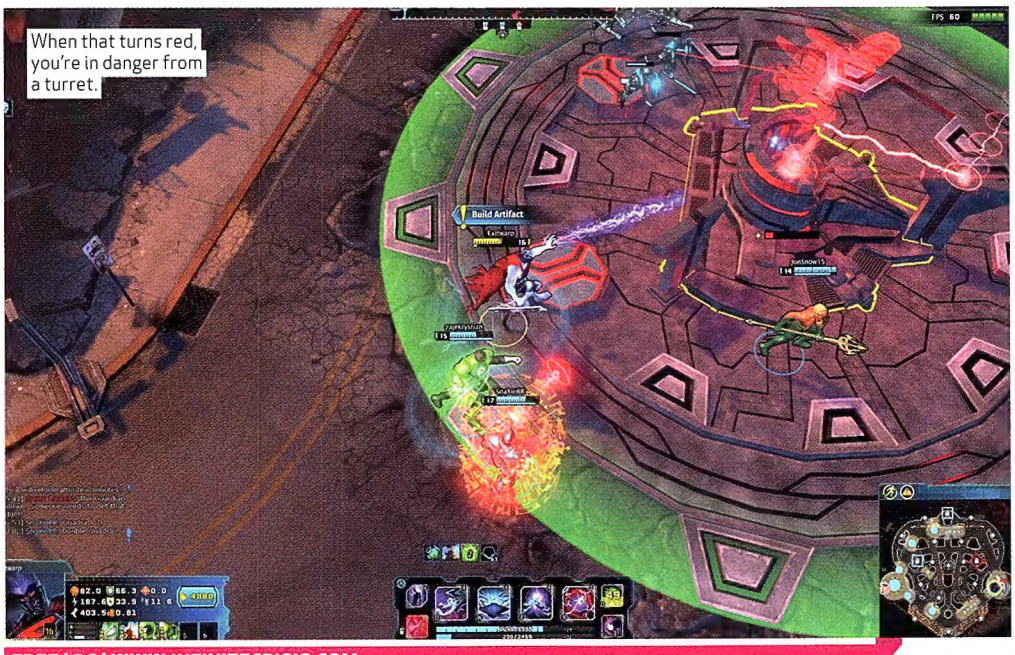
Squad has made it clear that 1.0 is not the last update, it's just the latest one. If you've already paid for one of the beta versions, you can download the release version for free.

■ Luis Villazon

Verdict

Improved aerodynamics; mine and refine fuel; fairings. But the career progression feels arbitrary.

★★★★☆



FREE | PC | WWW.INFINITECRISIS.COM

Infinite Crisis

Online ambitions clash with DC source material.

Joe Chill is, in most tellings of the story, the man who shoots and kills Bruce Wayne's parents. The gun that he used has never been particularly important in and of itself. After all, guns don't inadvertently create Batman – people do.

Nonetheless, firearm-brandishing Chill is one of the DC universe's founding images, and that's reason enough to shoehorn a reference to him into MOBA. In *Infinite Crisis*, Joe Chill's Revolver offers bonus attack damage and critical hit chance. Its fourth-tier upgrade, Deadly, increases critical damage by 50%. But it'll cost you 4,000 credits to get there, and that means killing robots that march down mirrored lanes from each team's fortified base towards the centre of the map.

Also, in *Infinite Crisis*, you're quite likely to build Joe Chill's Revolver on Batman. If you're reeling at the idea of Batman saving up to buy a souped-up version of the gun that killed his mum and dad, then you're probably a vDC fan.

GRAPHIC, NOVEL

Despite its failings as an adaptation, though, *Infinite Crisis* is an enjoyable game with a bunch of novel ideas. Strategic timing is important to every MOBA, but this is the first time we've seen the concept explained clearly to new players: in *Infinite Crisis*, a scrolling timeline at the top of the screen lets you know when to expect new objectives to become available across the map.

Those objectives are interesting, too. On the Coast City map, teams can capture a doomsday device by defeating its guardian. While equivalent to Dota's Roshan or League's Baron in principle, the impact of stealing an orbital superweapon is far more tangible. Similarly, characters with the super-strength power can lift certain environmental objects to create new pathways or throw them to begin a kill attempt. We also like the way certain abilities interact with the environment – like Doomsday's Charge, which gains bonus effects if you successfully slam an enemy champion into a wall. Where the superhero theme survives, it survives in the sense of power conveyed by abilities like this.

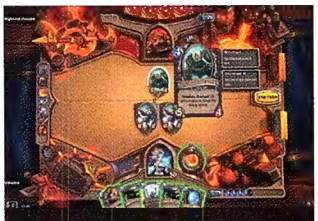
The game's dwindling community is a major issue, however. As of the time of this review, every map but one (Coast City) is disabled in regular matchmaking to shorten queue times. There should be single-lane and three-lane modes and a variant of *League of Legend's* Dominion map, but if you want to play these you'll have to wait for the scant evenings and weekends that they're made available.

This leaves *Infinite Crisis* in a tough position. It deperately needs to attract new blood, but it becomes less attractive with every player it loses. It's proof you can't just combine two popular things and create a different, equally popular thing. ■ **Chris Thursten**

Verdict

Inventive; handy scrolling timeline; free. Dwindling community.

★★★☆☆



Hearthstone: Blackrock Mountain

Burning down the house rules.

$31.99 | PC, MOBILE BATTLE.NET

There are hundreds of discussions to be had about value, and whether or not it's right to have to buy additional campaigns for Blizzard's now genre-defining digital card-based behemoth. But what it all boils down to at the end of the day is this: is it worth it?

While the content in Naxxramas was less than exciting, the same isn't true this time out and constantly throws up surprises during the seventeen boss fights of the game. Each of the five wings of *Blackrock* packs a series of battles designed to mess with your playstyle and decks. High Justice Grimstone for example,has a deck rammed with legendaries, forcing you to tinker with your minion loadout, replacing low-cost fodder with more hard removal abilities. Opening up a new enemy and rushing into your first papery duel with them is heady, almost Dark Soulsian stuff, as you reveal a little more of their deck each time you fight and use your accrued knowledge to tweak your loadout ahead of every new attempt.

Onto cards, though. There are some genuine surprises in store. The general makeup of the 31 new cards is a mixed bag. There are essentials to consider for every deck you build from now on. There are cards to earn and then instantly forget. Overall though, especially compared with Naxxramas, the theme is much more palatable. We'd definitely rather spend time in the company of dragons and ale-guzzling dwarves than screeching spiders. ■ **Matthew Sakuraoka-Gilman**

Video game car navigation a reality?

Holograms could give you a real-life racing line.

Swiss company WayRay has developed a product which could see traditional GPS navigators replaced with augmented reality navigation systems that place holographic waypoints right on your windshield. Best of all, it will be available to every car, regardless of how old the car is.

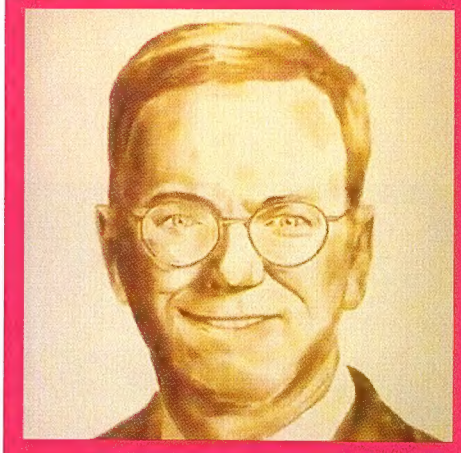
Called the WayRay Navion Holographic Navigator, the system's display will project onto your windshield from a small device to give you the illusion of arrows being placed directly on the road in front of you, so you won't ever have to take your eyes off the road. Navion is scheduled for a spring release.

GOOD NEWS EVERYONE: VR PORN IS A GO!

OCULUS HAS NO PLANS TO BLOCK VIRTUAL SMUT.

The sky's the limit when it comes to dreaming up virtual reality porn concepts, which is why we're happy to hear that Oculus VR has no plans to stop the adult entertainment industry from using its platform to create first person pornography, according to comments made at the Silicon Valley Virtual Reality Conference in San Jose, California.

When asked about the notion of X-rated content appearing on the Oculus Rift platform, Oculus founder Palmer Luckey (which is coincidentally a great porn name) responded by saying that, "the Rift is an open platform. We don't control what software can run on it, and that's a big deal."



Artist creates sh*tty portraits of tech CEOs

THIS ART IS LITERALLY SH*T.

An artist by the name of Katsu has made it his mission to create portraits of tech company CEOs made entirely from his own faeces. His first artwork, entitled 'Shithead 1', features Facebook CEO Mark Zuckerberg, while his latest arse-terpiece is focused on Google chairman Eric Schmidt, amusingly titled 'Eric Shit'.

Speaking to TechCrunch, Katsu explained that he's interested in what the human body is capable of producing on its own, and that he chose his subjects specifically because they "control every bit of granular data about individuals," and that "maybe faeces is the last thing that they could possibly control."

Google apologises for racist Google Maps

RACIAL SLURS LEAD YOU TO THE WHITE HOUSE.

Several racist search terms involving the N-word were found to be directing people right to the White House on Google Maps. When searched in the Washington area, the terms "n***** king, n***** house and n***** university, among others, would take Google Maps users to the residence of US president Barack Obama. Google released a statement on the matter, stating that "some inappropriate results are surfacing in Google Maps that should not be, and we apologise for any offense this may have caused." Google has since fixed this issue, though no one's entirely sure of what caused it. ■

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